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JOURNAL

OF THE

CANADIAN PEAT SOCIETY

Volume 3

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Room 22, Castle Building Ottawa, Canada

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Journal of the
Canadian Peat Society

Vol. 3 **April, 1914** **No. 1**

PRACTICAL PEAT UTILIZATION.

Address by J. N. Hoff, President of the American Peat Society, at the joint meeting of the American and Canadian Peat Societies held in Montreal, August 18-20, 1913.

The prime object of the American Peat Society is to further the practical utilization of peat, humus, or muck in the arts and agriculture—by co-operative work, by interchange of ideas among its own members and others, and by publication in its Journal and discussion at its meetings of the various processes of utilization in vogue; to unearth fraud, and point out, if possible, causes of failure in unsuccessful peat enterprises, and possible ways of success.

Much real work has been done, yet we can hardly say that we are even on the threshold of real success. Ignorance, prejudice, obsolete methods, and worse, have first to be cleared away, and, from the debris, ways and means must be devised to do successfully what in most cases heretofore has been failure of the most complete order.

The one great incentive to success is profit. What then is the most profitable way to use peat? Its uses are various, the principal one being, as we all well know, for fuel, litter, bedding, insulating and packing material, paper board, fertilizer filler, or as a direct soil improver and, in the form of peat or muck, in place of a soil for the direct raising of crops.

In the millions of acres in North America there is a vast difference in quality and character of peat deposits; therefore, the initial step is to examine and classify our deposits, which, coupled with location of markets for competing material, should determine what the particular deposit, if readily marketable, is best adapted for.

Peat for fuel should be low in ash, thoroughly decomposed, dense, and high in fixed carbon and the deposit must lie outside the territory of cheap coal or wood, as well as be accessible to and near a market.

Peat for litter or allied purposes must be only semi-decayed, light, porous, and very absorbent.

Peat for fertilizer filler must be high in actual humus and nitrogen content, well supplied with lime, and be naturally fertile as indicated by the natural growths thereon. Peat or humus soils, with characteristics similar to those mentioned, are adaptable to agriculture, if drainage and irrigation is possible and consuming markets are reasonably near at hand.

Choose, then your peat industry according to the character and location of your deposit if you would attain commercial success.

Undrained tide-level bogs are the most difficult to utilize as compared with those where real drainage is possible. Peat in such bogs must be taken out by bucket or hydraulic dredges, after which the various processes are similar to those used on drained bogs.

We refer you to G. H. Condict, Robert Ranson, and R. V. Fulton, of this Society, for practical suggestions as to handling undrained or tide-level bogs.

Bogs suitable for litter and the practical side of the peat-litter business in all its phases have been a life study with our most helpful Secretary, Mr. Julius Bordollo, who is always ready to shed light on this very important and, in America, greatly neglected peat industry.

Peat litter is five times as absorbent as straw, much cheaper to produce, and much more valuable as manure when spent. We in the States import several thousands of tons from Germany and Holland each year, regardless of the fact that we have within our borders peat beds containing the best litter obtainable. It is cheaper than cork and a better insulator. Why don't we utilize it?

You Canadians and our German friends have brought the fuel industry to success and your processes should render the peat-fuel industry of vast importance in the near future.

Then there is the valuable part the Mond gas producer plays in the peat-fuel problems. The Italian plants show in a most practical way that the whole process of preparing peat fuel and profitably utilizing it can be accomplished on the bog itself and the products carried to market by wire in the form of electricity.

Perhaps the most widely applicable and most general use to which peat of proper character can be put, however, is as a fertilizer or directly to produce crops—agricultural peat—which brings us to cleared and drained fields.

Large tracts of marsh or swamp land should be utilized if possible in order to afford proper machinery and carry out the project in such a way as to be economical and reduce the unit-production cost.

The best ditching device known to the writer for economical work is the ditcher made by the Buckeye Traction Co., and anyone considering the drainage

of bog lands should examine its advantages and cheapness of operation. Ditches 4 to 5 feet deep and 2 to 3 feet wide at the top can be dug with it for less than 10 cents per linear foot.

Large ditches 6 to 8 feet deep and 6 feet wide can be dug almost as cheaply, except for the added first cost of the larger machine.

Compared with any other method, clearing away trees and stumps is best done either with dynamite or with a caterpillar tractor, which will pay for itself in a short time. The same tractor will answer to pull your bogging machine, gang plows and power harrows, enabling you to plow and harrow 20 acres a day, which is more than 10 teams of horses and 10 plowmen could accomplish in the same space of time, even on a well-drained bog.

There are several good tractors of proper type now available, which should make agricultural work on peat lands practically horseless.

Drainage and clearing thus carried on by proper machinery will cost from $25 to $50 per acre.

Open ditches are better than tile drains for reasons that are obvious. In the case of a heavy downpour of rain on a large, flat surface, tile will not easily accommodate itself to volume; it is apt to clog, and the soft, yielding character of peat soil causes the tile to dip or raise and thus destroy the drainage levels.

On the other hand, open ditches can be made large, are easily kept clean, will effectively drain in a short space of time, and are much less expensive. They should be kept as free as possible from weeds, to insure good drainage, and prevent the spread of weeds to the cultivated fields.

For the production of filler or fertilizer on a drained and cleared bog, there is no better machine to dig, disintegrate, and spread the peat than one designed on the principle seen in James Dobson's peat digger. The proper use of his system should make the filler production a successful industry.

The fertilizer-filler industry has not been more successful mainly because the field work has not been attempted in a proper and comprehensive way.

Dewatering peat by various power presses has been a matter of much experiment but, as yet no marked success has been achieved. To attain success, such large masses of raw material must be handled at very low cost as to make the problem a serious one to work out in practice.

The success in filler production hinges on the method and cost of dewatering, as we have to reduce material containing 85 per cent. of water, or even more, to that containing 10 per cent. That means handling at least 6 tons of raw material to obtain 1 ton of finished product; and 5 tons of water must be disposed of.

The most logical way is by sun-drying on the bog or very near it.

On a well-drained bog a team can harrow 10 acres and readily disintegrate, pulverize, and reduce the moisture content of the top inch from 85 per cent. to 60 per cent. in 24 hours. An acre inch means 80 tons, or 10 acres 800 tons, of raw material containing 680 tons of water. When reduced to 60 per cent. of moisture, 500 tons of water has been disposed of by natural means, at a cost of a team and man with harrow one day; or with a Dobson digger, one day, 500 tons of peat containing 85 per cent. of moisture can be reduced to 180 tons, thus disposing of 320 tons of water.

What other method will approximate these in cheapness? Surely no press can do it. These figures are from experience in large areas and under average conditions of rainfall in the operating season, that is, from spring to fall.

When peat is reduced to 60 per cent. of moisture or less, it is friable, pulverulent, and easily subjected to further processes, rendering the completion of the drying process simple in almost any approved type of dryer that will dissipate 8 pounds of water for each pound of coal consumed .

With coal at $3 per ton, the fuel cost of drying peat, from a 60 to a 10 per cent. moisture content will approximate 60 cents per ton of finished product.

Similar methods can be used in treating undrainable bogs, by first pumping the raw peat to suitable drying grounds.

One of the more recent uses of agricultural peat has been its preparation by disintegration and drying for direct application to upland soil to supply the needed organic matter or humus, in place of plowed-under green crops or manure.

We are approaching a horseless age. Supplies of manure are increasingly difficult to procure; it is unsanitary for transportation and use, and requires many times more in volume to give the same results produced by prepared peat or humus. Here is a vast and almost untouched field for peat utilization.

Professor Thompson will tell us how valuable this product is in greenhouse work, in place of the old manure-sod soil, so expensive to make and so uncertain in character and composition. He can also tell us how valuable is agricultural peat in place for the production of truck crops, perhaps, after all, the most profitable and lasting branch of peat utilization for steady profit and the greater good to mankind, in the role of vegetable food production.

ECONOMIC UTILIZATION OF OUR PEAT RESOURCES.

Arthur J. Forward, B.A., Secretary Canadian Peat Society.

Paper read at the Joint Meeting of the American and Canadian Peat Societies, held at Montreal, August 18-20, 1913.

The true aim of conservation is the prevention of waste. Wasteful methods of utilization of the natural resources of this continent have been responsible for enormous losses in the past. The destruction of the forests affords a striking example. The Indian fired the forests to drive game, to permit growth of berries, or sometimes to impede an enemy. When the white settler came in he reduced the forests to ashes to clear the land. Fires caused by operation of railroads, brush-burning, camper's fires and other causes have eaten up millions of dollars worth of timber annually. The direct losses occasioned have been many times exceeded by the indirect injuries. Vast areas have been rendered treeless, streams dried up, destructive floods caused, quality of the soil deteriorated, climate changed for the worse through changes in rainfall and violence of winds, causing damage which cannot be estimated in dollars.

Even in the attempt to utilize our forests there has been enormous waste. Only the immediately saleable forest products have been salved and materials of great economic value have been left to rot in the woods, or to increase the danger of forest fires. Our rivers and streams everywhere have been polluted with sawdust and waste from the mills.

The mining of coal has frequently been so carried on as to result in the saving of only a small percentage of the deposits. The bison of the Western prairies were exterminated for their skins. The seal have been ruthlessly slaughtered. Our fisheries have been depleted and greatly injured by disregard of the necessity to allow nature opportunity for recoupment and regeneration.

It would be easy to accumulate statistics touching almost every branch of development of the natural resources of the country, to drive home the fact that we have been guilty of squandering our natural wealth with very small and entirely incommensurate resulting benefits to ourselves.

A source of wealth which has lain latent for centuries is to be found in our peat bogs.

The United States, exclusive of Alaska, is estimated to have 11,200 square miles of peat bogs, averaging 9 feet in depth, and containing nearly 13,000,000,000 tons of fuel worth at $3.00 a ton—$39,000,000,000.

Canada has 37,000 square miles (23,680,000 acres) of known peat bogs, but these form probably but a small fraction of the total, constituting a potential national asset of enormous value.

These bog areas have been viewed in the light of an obstruction rather than as a possession of any value. They were useless to the agriculturist. They grew no timber of any value to the lumberman. They were in the way of road and railway builders.

Peat is still looked upon by many people in this country as something valueless, and to be got rid of in the easiest way possible. The method usually employed is to burn off the surface peat, laying the land beneath open to the operations of the agriculturist. In a recent case in Ontario on an appeal from a Court of Revision as to assessment of peat lands, a professor in an agricultural college is reported to have testified that the lands in question were absolutely worthless for agriculture unless the water was drained out down to the clay. If the property was drained down to the clay the peat could be burned off, leaving land suitable for agriculture.

There can be no quarrel with the decision of the Court lowering the assessment, nor with the statement as to drainage. But serious exception can and ought to be taken to the suggestion of burning off the peat to get rid of it.

A news item from the New Westminster Columbian affords an instance of the popular view of the matter.

> "Peat fires of greater or less size have burned viciously in various sections of Lulu Island east of the No. 4 road this week. Consequent upon the drying weather of the past three weeks, the peat bogs have been robbed of their moisture and the application of a match is required to set them on fire. Efforts at fire fighting have been slim for the most part, as the fires are on land lying idle. The odor of the burning peat permeates the atmosphere for several miles around."

Because the peat bogs cannot at the present moment be turned to practical account, it is assumed that their destruction is of no significance.

The economic results which can be obtained through intelligent development of our great peat areas are however important. Assuming that a given area of 100 acres is covered to an average depth of 5 feet with peat adapted to the manufacture of fuel, this would yield about 100,000 tons of fuel, worth at $3.00 per ton, $300,000. It would furnish sufficient fuel to supply 100 families for 50 years, allowing 20 tons per annum to each family, or if burned in gas producers would supply a power plant of 400 h.p. with fuel for 50 years of 300 ten hour days per annum. And if proper methods were observed, there would be left at the close of the operations, 100 acres of highly valuable agricultural lands in place of a barren moor of the same extent. Large areas of the best lands in Holland have been created by reclamation of the moors.

By burning off the peat as suggested it is true that some fertilizing effect might be obtained from deposit of peat ash on the clay. But apart altogether from any value the peat itself may have, the valuable results obtained by mechanical admixture of a layer of peat with the top clay soil, as practiced so successfully in Holland and elsewhere is entirely lost. The result obtained by such method is the addition of a few acres of heavy and hard working soil to the farming area, where by proper treatment soil of the highest fertility and physical qualities would be secured. The value of saving a part of the peat to enrich and enlighten the heavy underlying clays is so well appreciated in Holland and elsewhere in Europe that laws have been framed requiring the operators of fuel plants to leave a foot or more of peat on the bottom of the bog.

Where do we stand at the present time in relation to any extensive development of our peat bogs? Have we not reached a point where it is desirable that there should be some kind of a stocktaking of our peat resources, and of the means at our disposal of utilizing them to economic advantage?

Leaving out of the question for the time being the whole field of those forms of utilization of peat which are still largely in the speculative or theoretical stage, could we not profitably concentrate our energies on the extension of those uses which have in this or other countries already reached the stage of commercial success?

The outstanding fact in relation to the industry is that what is known as "Machine made peat fuel," is now being made commercially in large quantities in Europe, and a commencement has been made on this continent.

The high labour costs in this country have stood, and will continue to stand, in the way of our adoption of machinery which has been successfully employed in Europe. The development of more efficient plant involves, however, purely mechanical problems, and I believe that the actual demonstrations to be witnessed by the Societies during the course of these meetings will convince every one that some progress at least has been made towards their solution.

The great drawback is the shortness of the working season. But even this handicap has not prevented successful operation in Europe, and it may be definitely accepted at the present time that no economical method of overcoming the difficulty has yet been devised, or is even in sight. We will reach definite results soonest and with least outlay and loss by facing this fact.

A further development which may be regarded as having fairly reached the commercial stage is the application of peat fuel manufactured by the "Open air" process to use in gas producers for the production of power, either with or without recovery of by-products.

The results obtained at the government fuel testing station in Ottawa afford a conclusive demonstration that provided a sufficient supply of peat fuel is available at a cost not to exceed say $2.00 a ton at the plant, a very efficient and cheap production of power is obtainable.

At Pontedera, Italy, with the production and sale of electric power from peat gas there is being combined the manufacture of sulphate of ammonia as a by-product. This is a product for which the market is practically unlimited, and always increasing, with prices in the vicinity of $60 to $70 a ton. Some of our Canadian bogs are rich in nitrogen and apparently well adapted for production of sulphate of ammonia.

Then we have the production of moss litter which is in Holland especially an important business in a stable position. Given a suitable bog, and the right conditions as to markets, transportation, etc., there seems no reason why this business should not materially increase on this continent. The use of peat in connection with the manufacture of chemical fertilizers as a filler, is an established fact.

Last but not least there is the agricultural development of peat lands. With some of the European Societies this is the all-important branch, and in Prussia, Holland, and other European countries the governments devote very considerable sums annually to this end. It is a matter which must become of great interest in Canada, and is already attracting much attention in the United States. Arrangements have recently been made by which the United States Department of Agriculture will conduct an extensive series of tests looking to the agricultural development of peat lands. In the Canadian Northwest are enormous areas of bog land which from insufficient depth or character of the peat are unsuitable for production of fuel or moss litter. With proper drainage and intelligent treatment these waste areas will become garden spots of high fertility and productiveness. The utilization of the vast peat areas along our Transcontinental Railway will eventually not only serve to populate the country, but is likely to have a directly beneficial climatic effect. In the older portions of Ontario the drainage and reclaiming of low lands has has an undoubted effect in lessening the liability of crops to killing frosts early and late in the season.

Outside of the field of activity thus outlined there is a debatable ground of various operations for the utilization of peat which is still in the realm of theory and speculation.

The attempts to express the water from peat mechanically, to dry it by artificial heat, to make peat briquettes which shall have a density and a fuel value approaching that of good coal, to produce peat coke, etc., have absorbed millions of dollars of capital without practical results on any commercial scale. Even the

much advertised Ekenberg Wet-Carbonization process of making peat-coal has not yet, in spite of work and enormous outlays, cut any figure whatever commercially.

With these may be classed the various artificial fuels using peat in combination with petroleum and other substances.

Prior to 1902 it is said that about 400 patents had been issued in the United States on artificial fuels, but none had proved a commercial success.

Paper making from peat fibre has not yet proven of value, and so long as we possess enormous quantities of available spruce and other timbers, does not appear likely to make much headway in this country.

We have then as practical avenues of immediate commercial development:

(1) The manufacture of "Machine Peat Fuel" made by the "open air" method with adoption of mechanical appliances superior to those in use in Europe.

(2) The production of power from peat burned in gas-producers.

(3) Manufacture of Sulphate of Ammonia and incidental by-products.

(4) Manufacture of Moss litter.

(5) Utilization of peat in the production of chemical fertilizers.

(6) Agricultural development of peat lands; and probably a number of applications of peat of minor importance.

The development and improvement of the machinery necessary for all these purposes, as well as the carrying on of actual operations, affords ample scope for the legitimate investment of private capital, but there is absolutely no room in the peat industry for the professional promoter.

We should urge upon our governments the importance in the public interest of investigation and classification of the bog lands of the United States and Canada, and the furnishing of such information as will lead to the best economic disposal of the capital and energies available for the peat industry. Just as our Department of Mines explore mineral lands and report on those areas most likely to yield commercial results, they should provide the public with such reliable data as to location, extent, depth and quality of peat of the various bog-lands and other information as will constitute a safe guide with regard to their adaptability for commercial development along lines which have already proven a success.

So far as Canada is concerned this paper would be incomplete without some reference to the valuable work already done by the Department of Mines under the judicious guidance of our Honorary President, Dr. Eugene Haanel, Director of Mines.

Eleven or twelve of the more important bogs in Ontario have already been investigated, mapped and reported upon by the Department. Preliminary investigations of a number of bogs in Manitoba have also been made by Mr. Anrep, who is now engaged in similar work in Quebec and the Maritime Provinces. The results of these investigations have, excepting those of the present season, been publishd as Bulletins of the Department.

Last winter, at the solicitation of the Canadian Peat Society and others interested in peat development in Canada, the Department sent Mr. B. F. Haanel, Chief Engineer of the Fuel Testing Division, and his assistant Mr. John Blizard, to Europe to make a special investigation of the peat gas producer power plants, and ammonia recovery plants there. A special report giving the results of this investigation is now in course of preparation and may be expected to appear before long.

It is only by such concerted and intelligent effort directed to the special development best adapted to each particular bog that the best results for the public can be obtained from exploitation of our peat bogs, and for the people who invest their money in the work of development as well.

It is essential to the very existence of the peat industry on this continent that the efforts and capital of investors shall be directed solely along those lines of actual production which give fair promise of immediate financial return, based on the actual experience of those who have made a commercial success of any particular phase of the business.

The function and work of the Peat Societies, both American and Canadian, is not confined to the encouragement of legitimate operations, but they should equally and just as actively discourage waste of money in such speculative schemes as are bound to involve ultimate loss of the capital invested and to bring discredit on the industry. The public, when it comes to talk of peat, are from Missouri, and want to be shown. A ton of peat fuel made under conditions which will allow dividends to the producer, is a better argument than any amount of theoretical discussion.

We have as Societies, moreover, a direct duty and responsibility to the public in the matter. It is necessary that we should probe to the bottom every statement made by inventors and promoters, and as far as possible sift the false from the true. There is a danger that in our anxiety for the welfare of the industry we may allow ourselves to be blinded as to the misleading character of many statements, and lulled into an optimistic belief that, "Whatever is, is right."

Items appear in the general press of the country from time to time which are absurd in their very nature. Take this example in a recent issue of "Steam" referring to a method of mining peat with a hydraulic dredge.

> "A novel method of moving peat from the bog is in operation near Lakeville, Ind. The dredge is equipped with a rotary cutter extending across its bow, which cuts a swath 26 feet wide and to the full depth of the bog. The suction pipe of a

centrifugal pump follows immediately behind the cutter. The pump takes the raw material from the bog and delivers it into drainage bins located on the bank, 24 feet above the level of the bog. There are three of these bins, each having a capacity of 3,900 cubic feet. Each bin is 42 feet long and is provided with a chain drag conveyor extending its full length. It requires about 10 hours to fill a bin. It is then allowed to stand for 48 hours, when its contents are thoroughly drained. Five and one-half tons of the material, as delivered to the tanks, yield, after 48 hours' draining, one ton of peat containing 12 per cent. moisture.

If this were true there would be a rush for peat bogs, almost like a Klondike stampede. But it is simply ridiculous, as we all know.

Much has been heard in recent years as to the depletion of the coal areas of the continent. Wood is fast disappearing as a fuel. The intelligent development of the fuel and other resources latent in our vast peat bogs may therefore be regarded as a measure of practical conservation, provided the methods of development followed are such as to secure the highest economic return from every bog utilized taking into account its particular character and situation.

OIL FROM PEAT.

By Mr. J. E. Ray, Birmingham, England, Sept. 17th, 1913.

Notable results are now being obtained from the distillation of peat by the Del Monte process. Treated by the Del Monte retorts, peat yields a high percentage of oil, purer and better than that obtained from many oil wells. The residue in the retorts after distillation is a high grade coke, well suited for use as a smokeless fuel. By carrying the distillation point to a slightly higher temperature an ideal coke is obtained for metallurgical purposes, and able, because of its hardness, to withstand any pressure in a foundry furnace. Owing to the absence of sulphur and silica the coke is superior to that obtained from coal. It is practically pure carbon, resembling the charcoals used in Sweden for smelting the best steel, with the advantage of hardness which charcoal does not possess. Other by-products include sulphate of ammonia, for which there is an ever-increasing demand for agricultural purposes.

Recent tests have been carried out on a commercial plant of full size. These included samples of peats from most diverse districts, and all of these yielded a remarkably even average of 40 gallons of oil per ton of dry peat. It is claimed for this oil that it is admirable for naval use and for engines of the Diesel type, while 20 gallons of motor spirit are obtained from it for use in petrol engines.—*Weekly Report, Department of Trade and Commerce, October 6th, 1913.*

THE DEL MONTE PROCESS.

We have recently inspected the Del Monte plant for the distillation of oils from coal, shale, cannels, peat, &c., now working on a commercial scale at the London works of Messrs. Oil and Carbon Products Limited.

When the Del Monte process first came to light, the claims made for it were so striking that a good deal of criticism was levelled against it, based on the fact that it was only proved on an experimental retort. The contention was that the results obtained could never be repeated on a commercial scale. It is gratifying to note that in this instance the critics were wrong, as the commercial plant at Chiswick gives even better results than the original experimental plant.

In the Del Monte process, every hydrocarbon evolved is immediately brought into a cooler region within the retort and is condensed by contact with cooler material. Low temperatures are not essential; high and low temperatures may be used according to the material in treatment; every fraction of hydrocarbon is distilled at the precise temperature at which it will vapourise, and is immediately condensed. The Del Monte process cannot, therefore, be classified among either the high-temperature or the low-temperature distillation processes; it constitutes a class of its own, and represents the rational method of distillation of carbonaceous materials.

The retorts are constructed at a slight angle from the horizontal in batteries of four units, working in unison. The coal or other material under treatment is charged continuously and automatically into the lower end of the retort, where distillation takes place, towards the upper end, where it is discharged automatically in the form of coke. The time taken by the material to pass through the retort varies from 45 to 75 minutes, according to its nature. The temperatures are graduated from 30 degs. Cent. at the charging end to 450 degs. Cent. at a point about two-thirds of its length, where full distillation takes place. The further portion of the retort is not heated, and acts, together with the discharging hopper, as a cooling chamber for the coke, and incidentally as a heating chamber for the gas, which is used as a conveying medium for the vapours formed. The gas used for this purpose is the surplus uncondensable gas obtained in the process itself; it is forced through the retort from the lower end of the discharging hopper through the mass of heated coke, absorbs its heat and imparts it to the material in treatment further along the retort, and finally escapes at the lower end in a cool state. The coke or other residue is discharged also in a cool state; the wasteful operation of quenching with water is thus entirely avoided, and a remarkable economy of heat effected. The main function of the uncondensable gas, thus passed through the retort, is to pick up the oil vapours, wherever

evolved, at the very moment of their formation, and to convey them to relatively cooler zones, where they at once condense by contact with the incoming material. All the oil vapours, with the exception of those lighter fractions which will not liquefy under atmospheric pressure, are condensed in this way within the retort itself. The condensate or oil flows out of the retort straight into the tanks. The lighter fractions are recovered in the scrubber by washing the gas in the usual manner. The absence of condensers is a remarkable feature of the Del Monte plant, and means a considerable saving in cost of plant and working.

The importance of the Del Monte process to the colliery owner is considerable, as it provides a means of turning into value the slack, coal dust, and lower grade coals. An enormous amount of oil can be produced in this country from this source alone.

The Del Monte process is particularly well suited for the distillation of oil shales; for this industry, its advantages are even more striking than in the case of coals.

There is yet a further field for the Del Monte process. In this country there are over 5½ million acres of peat bogs all at present regarded more or less as waste lands, but which, by the installation of Del Monte retorts, could be converted into prosperous centres of industry. An average of 35 gallons of oil per ton of air-dried peat can be obtained, in addition to a coke of excellent quality; the latter being practically pure carbon, suitable both as a household fuel and for metallurgical purposes. The quality of the oil obtained from peat is also exceptionally high.

The present commercial plant has been specially designed for the treatment of cannel coals and has been in continuous working since January 1; the half size retort which has been the subject of so much criticism is still doing very well; it is housed next to the laboratories, and is in daily use for tests of the various materials which arrive from all parts of the world.—*The Colliery Guardian.*

FRANKE PROCESS.

In the Franke process for the utilization of peat, which is being worked experimentally in a small plant at Acton-green (England), the raw material is first passed through a disintegrator and is then pressed to reduce its water content. The press employed is of special construction, designed to permit the free escape of the water, and consists of a cylindrical container within which is arranged a series of concentric rings or partitions, placed vertically and parallel to the outer casing. The peat is packed into the spaces between these partitions, and hydraulic pressure is applied to it from below. The partitions have both their sides formed of wire gauze and are hollow, and thus the water squeezed out from the peat, readily drains away at a large number of points. It is stated that by this treatment the water in peat containing initially 85 per cent. moisture can be reduced to 30 or 35 per cent., and that the resulting product is then in a condition in which it can be submitted to dry distillation with the object of producing coke, gas, and tar, the last yielding, by appropriate manipulation, motor-car spirit, heavy oil suitable for steam raising purposes and various other products. If a still larger reduction in the amount of contained moisture is required, as is the case when the material has to be used for making briquettes, the peat before being pressed is heated for five minutes in a special apparatus to a temperature of about 90 degrees Fahr. The object of this preheating is to break down the hydrocellulose and thus facilitate the elimination of the water in the subsequent pressing. Finally the peat cake is pulverized, when it is ready for the manufacture of briquets.—*The Times (London) Engineering Supplement.*

PEAT POWDER AS LOCOMOTIVE FUEL.

Peat powder has been successfully applied as a locomotive fuel on one of the private railroads in Sweden. In steam raising value about 1½ tons of peat powder is equivalent to one ton of coal. Peat powder is used with a mixture of about 5 per cent. of coal, and is fed into the furnace by an automatic stoker. No change needs to be made in the boiler end of the fire box, except for the mounting and application of the automatic stoker. An incidental advantage of the use of the peat powder is that no cold air can get into the fire-box and no smoke or sparks escape from the smoke-stack. As Sweden is very rich in peat bogs, and has practically no coal deposits, the success of the apparatus, which has been worked upon for years by eminent engineers, is of considerable importance. It has been estimated that the cost of peat powder would be only one-half that of coal.—*Machinery.*

GAS ENGINES.

Despite the adverse conditions, the use of the internal-combustion motor grows more wide-spread, and business during 1913 was exceptionally good—probably the best on record; and while the gas-engine trade would have been still larger today had it not been for the advent of the Diesel (the talented inventor of which died in tragic circumstances during the year) and the semi-Diesel engines (which compete with it in the larger and smaller sizes respectively) it is nevertheless in a healthier state than ever previously. This statement refers mainly to the producer-gas engine, although the use of coke-oven and blast-furnace gas for motive power has shown considerable increase. There is still much to be done in this direction, and manufacturers may regard it as one of their best spheres, for the economy in operation at mines and steel works is very great. This point is all the more to be emphasized by a consideration of a probable increase in the amount of coal, which will be subjected to destructive distillation for the production of heavier and lighter oils. The number of very large gas-engine units built for this country has, however, not been great, but as with the present relative prices of gas and oil the gas-engine shows to good advantage in fuel costs, the demand for the small and medium powered producer-gas plant is extremely brisk.

Few novel features were introduced during the past twelve months in gas-engines, the chief point of interest being the increasing employment of fuels other than coal in places where they are readily obtainable. Sawdust is giving good results in numerous cases, while peat and charcoal are also employed with advantage when slight modifications are made in the producers. So much experience has been gained with the gas-engine during the last decade that one is inclined to consider its design as near the limit of perfection as that of the steam-engine, at any rate as far as the present-day type is concerned. But the gas turbine still remains an unsolved problem commercially, and there is absolutely no practical development to be recorded during 1913. The Holzwarth machine, from which at one time a good deal was expected, has up to the present received no real application, and although several inventors are now working on a type in which water is injected into the turbine, no definite progress is to be recorded.

Only in one phase does the development of the gas-engine seem to be at a standstill—its use for marine purposes and the hopes that were raised a few years ago are far from being fulfilled. It is now generally felt in most quarters that the future of the marine internal-combustion engine lies in the oil motor, and, although there are certain engineers who take the opposite view, their number is not great. A few gas-engine driven vessels were put into commission during the

year, but apart from one motor coaster with two 150-h.p. motors, they were mainly barges with engines up to 100 h.p., and usually not much over 50 h.p. They were practically all built on the Continent, and chiefly in Holland.—*London Times Engineering Supplement.*

SULPHATE OF AMMONIA.

BRITISH EXPORTS, 1898-1912.

	Quantities	Average Prices	Values
	Tons	£ per Ton.	£
1898	137,604	9.37	1,290,031
1899	140,332	11.09	1,556,372
1900	145,157	11.28	1,636,678
1901	149,884	10.72	1,607,176
1902	162,611	11.50	1,869,395
1903	162,110	12.30	1,994,278
1904	177,253	12.25	2,171,445
1905	189,106	12.59	2,381,568
1906	201,402	12.22	2,460,689
1907	231,460	11.89	2,752,931
1908	234,282	11.80	2,763,584
1909	264,142	11.47	3,030,452
1910	283,610	11.91	3,376,708
1911	291,148	13.12	3,819,747
1912	285,043	14.00	3,991,262

PRODUCTION OF AMMONIA SULPHATE.

Messrs. Bradbury and Hirsch, in their review of the sulphate of ammonia market in 1912, estimate the following as the world's production in that year:—

e.	Tons
Germany	465,000
United Kingdom	379,000
United States	165,000
France	68,500
Belgium	49,500
Austria-Hungary and the rest of Europe	170,000
Total	1,297,000

—*Colliery Guardian.*

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AMERICAN PEAT SOCIETY.

The Eighth Annual Meeting of the American Peat Society will be held in Duluth, Minn., on August 20th, 21st and 22nd, 1914. President John N. Hoff, 17 Battery Place, New York; Secretary-Treasurer, Julius Bordollo, Kingsbridge, New York City.

AGRICULTURAL DEVELOPMENT OF PEAT LANDS.

The United States Department of Agriculture has made arrangements with the American Peat Society to carry on co-operative work on the agriculture of muck or peat soils. The agreement was substantially that the Society should furnish enough selected peat land of agricultural value on which to carry out carefully planned field experiments with a variety of crop plants known to be adapted to muck soils, and furnish the labor to care for the crops. In addition, enough of the peat from the land selected was to be furnished the department to permit a series of green-house experiments, already begun by the Bureau of Plant Industry, to be continued during the lifetime of the co-operation.

The Department of Agriculture agreed to furnish all the supervision and seed required for the detailed work and placed the matter in charge of the Bureau of Plant Industry, Division of Horticulture.

The Society placed the matter of arranging details of the work in the hands of a committee of members who were successful and practical truck farmers and owners of considerable areas of peat land. The editor of the Journal of the American Peat Society was added to the committee as the arbiter who should select the type of peat deposit on which the experimental work should be done.

The actual field work was placed in charge of Professor H. C. Thompson by the Chief of the Bureau of Plant Industry.

In order to start this important work promptly, the President of the Society offered as much of his farm in New Jersey as would be needed for the first year's tests. This offer was at once accepted by the committee, as the land was typical of great areas of drained and drainable swamp land in the eastern part of the country. The experimental work was begun and carried on through the summer. The greenhouse work had also been carried successfully through a season and is being followed up by a second season's test of the same muck. The season proved exceptionally dry and the results of the field experiments, from the point of view of the investigator, not as satisfactory as they would have been if the rainfall had been normal. The records of the season's work were carefully kept, however, and will be reported later.

Work for the coming season has already been planned, and, in addition to continuing the work in New Jersey, similar work will be started on one of the Todd farms, that at Mentha, Michigan, where the muck and the climate are considerably different from those in New Jersey.

One of the things aimed at in this work is to make it as broadly general as possible so that the greatest number may reap the benefit, and in order to do this, muck lands of different types, at least so far as the origin of the deposit, conditions of climate, stages of decomposition, drainage, etc., are concerned will be selected for each series of tests.

A very interesting paper on the greenhouse experiments conducted by the Burau of Plant Industry was read by Prof. H. C. Thompson at the joint meeting

of the American and Canadian Peat Societies last August. The results of tests will be published both by the Department of Agriculture and the American Peat Society.

USE OF POWDERED FUEL.

Fuel economy and the intimately associated problem of smoke abatement are receiving much attention. Among the methods discussed none perhaps is of greater interest than the burning of powdered coal. The experiments made in this direction are of especial value to all who are interested in the utilization of peat. The work done by Lieutenant Ekelund in Sweden has already demonstrated that peat has very great possibilities when used in powdered form. Its composition and physical properties make it in some respects superior to coal for this purpose.

The requirements for best results in burning powdered coal are thus stated by an authority.

(1) Coal must be dried to contain not over 1 per cent. of moisture.

(2) It must be pulverized to a high degree of fineness.

(3) It must be projected into a chamber hot enough to cause instant ignition.

(4) It must be supplied with sufficient air for complete combustion.

The standard of fineness given by the same authority is:—90 per cent. through a 400 mesh screen; 2½ per cent. to 5 per cent. through a 200 mesh screen, and the balance through a 100 mesh screen.

The cost of preparation of coal is variously estimated at from 32½ to 36½ cents per ton, with power at 1½ cents per kw. hr.

It must be kept in mind that there is present in powdered fuel a certain percentage of extremely fine material, depending on the character of the fuel, its moisture content, and method of pulverization. The character of the flame is materially influenced by this impalpable dust which gasifies instantaneously.

The physical structure of peat is such that a large percentage of very fine powder would be more easily obtainable than in the case of coal, thereby increasing the rapidity of combustion.

Another point in favor of peat powder is the usual high content of volatile matters in peat. There is much divergence of opinion as to the amount of volatile matter required in coal to render it suitable for burning as powdered fuel. The majority of writers seem to think that 30 per cent. of volatile matter is a prerequisite, but some report satisfactory conditions with but 20 per cent. The higher the volatile the larger amount of the combustible will be converted into gas by the mere application of heat, and the more rapid and perfect the combustion. Ontario peats examined contain as high as 60 to 70 per cent. volatile matter, and should produce a highly efficient powdered fuel .

As in the production of peat fuel generally the important question is the removal of the moisture at such cost as to render the fuel economic.

THE USE OF PEAT IN HOLLAND.

Probably in no country have peat deposits been put to such a systematic and abundant use as in Holland, from early times. By a large outlay of capital combined with intelligence and skill, the native bogs and marshes have been drained by canals. These ditches were made of such a size that they not only served to drain the water from the peat deposits but at the same time could be utilized as ship canals. The peat, made thus accessible, is dug out, dried and pressed into brick-like form. The peat bricks are loaded on flat-bottom boats on the peat canals, which join the chief canals that exist all over Holland, and are thus transported to the places where they are used. As return freight these boats are loaded, after discharging the peat, with street or other refuse, which cities are glad to dispose of and even deliver it free to the boats. This refuse is used as fertilizer on the soil from which the peat has been removed. By this method a large part of Holland not only obtains cheap fuel, but, yearly, large marshy tracts are made accessible and turned into profitable agricultural soil which gives farmers an opportunity to own good and profitable property. Yearly new colonists settle in such places, thus continually increasing the agricultural acreage, and the colonies generally flourish. The canals are also handy to these settlers, as they form easy and cheap routes for shipping their farm products either to the cities or for export. Even German markets receive a considerable quantity of vegetable products from these peat colonies.—*Electrotechnische Rundshau.*

LAND RECLAMATION IN HOLLAND.

At a recent meeting at Arnhem of the Nederlandsche Heidemaatschappy (Netherlands Heath Co.), a national organization for reclaiming marshy and other waste lands and of generally aiding agriculture, forest culture, etc., a speaker said that there was in this country more than 250,000 acres of the best soil still under water. This does not refer to the soil under the Zuyder Zee, which it was proposed to drain half a century ago—a project still discussed pro and con; nor to the soil under rivers and canals, but only to that under useless water. Yet drainage has been steadily prosecuted for centuries in this country, and the area being reclaimed at present amounts to between 20,000 and 25,000 acres a year.

The Heath Co. is doing an important and valuable work, not only toward reclaiming waste lands and assisting agriculture, but also by turning many reclaimed tracts into much-needed forests. That its work is appreciated is shown by the fact that a special building has just been erected and furnished for the Company at Arnhem, costing about $50,000 and paid for out of public funds.—*Journal of the American Peat Society.*

THE INTERNATIONAL NITROGEN AND POWER CO., LIMITED.

The above Company has been formed in London, England, with a capital of £330,000 to acquire and operate under patents covering the Buckle process. The methods of handling the peat employed in this process are thus described in a report made by their consulting engineer.

(1) The peat is excavated from the bog by an electrically driven dredger type excavator.

(2) It is conveyed by electric haulage in wagons to the factory on or adjoining the peat bog, where

(3) It is elevated and passed through a macerating machine.

(4) Its percentage of water is then made up from 80 per cent. (the average content of water in the peat bog) to 92 per cent.

(5) It is pumped and maintained at about 150 lbs. pressure per square inch through:—

(a) The heating chamber of special design, to

(b) The electrolizing chamber, and then

(c) Into the filter press where the water is extracted and in which the peat cake is produced, the pressure being automatically controlled by specially designed retaining valves.

The peat cake thus produced is ready for immediate use in a moist combustion plant, and from it Sulphate of ammonia, tar, and other by-products, and power gas are recovered. A plant capable of handling 600 tons of raw peat daily is estimated to cost £50,000. On a basis of 2.3 per cent. of nitrogen in the bog such a plant is estimated to yield 1750 tons of sulphate of ammonia per annum, which at £12 per ton would be worth £21,000.

The power used would be obtained from the gas produced in the ammonia recovery process, and it is estimated there should be a considerable quantity of power gas available over and above that required in the process. A small experimental plant has been operated capable of dealing hourly with 350 lbs. of macerated peat containing 92 per cent. of water (28 lbs. of dry peat per hour). The electrolizing chambers employed in the test plant were on the full scale that would eventually be adopted, and were capable of treating six tons of peat pulp per hour.

It is stated that this small plant has worked satisfactorily with uniform results, producing a peat cake containing from 65 to 67 per cent. of water. It is also claimed that if the peat cake obtained is needed for fuel purposes, a few days supplementary air drying is all that is necessary as the peat cake dries

easily and quickly on exposure to air, the cake contracting and forming a dense coherent mass as it dries. Experiments made with the peat cake showed that it could be easily coked, giving a dense coke of excellent quality.

So far as production of peat fuel is concerned it may be pointed out that it is proposed to resort to supplementary air drying to reduce the moisture in the peat cake from 67 per cent. to 25 or 30 per cent., which is approximately the percentage of moisture allowable in peat to be used as fuel. This would naturally involve extra handling, and it would appear extremely doubtful whether fuel could be produced anywhere near as cheaply as by resorting to air drying in the first place.

As regards production of sulphate of ammonia, the profits arising from the recovery of sulphate of ammonia will be materially affected by a very slight increase or decrease in the nitrogen content of the peat treated.

Several bogs examined in Ontario average well over 2 per cent. nitrogen content, although others fall considerably below this figure.

The operations of the Company will be watched with interest on this continent. So far the wet carbonization method of Dr. Ekenberg does not appear to have become commercial, and there will be naturally a good deal of doubt whether the electrical treatment now proposed in connection with the elimination of surplus moisture will prove any more successful.

PEAT MOSS.

UNITED STATES IMPORTS, 1908-1912.

	From Netherlands		Total	
	Tons	Value	Tons	Value
1908	7,849	$46,111	8,130	$47,829
1909	7,477	41,389	8,371	46,222
1910	7,747	42,354	7,872	43,082
1911	8,186	41,541	8,277	42,052
1912	8,305	39,983	8,393	40,421

—*(Foreign Commerce and Navigation of the United States).*

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Canadian Peat Society

Vol. 3 **JULY, 1914** **No. 2**

THE BACTERIAL TREATMENT OF PEAT.

By W. B. Bottomley, M.A., Ph.D., F.L.S., Professor of Botany and Vegetable Biology, King's College, London.

(From Journal of the Royal Society of Arts).

If the statement be true that "the soil is the basis of national wealth," the problems of soil fertility and plant production are not merely of interest to farmers and gardeners, they are of national importance.

Since the days when Adam tilled the earth in "the sweat of his face" down to the present time, the question of food-supply has been one of the dominant factors of man's existence. As time goes on and populations increase and their needs become greater, this question of food supply will become more and more acute. Some writers have already given us terrifying pictures of this food famine of the future. But man's necessity is science's opportunity, and the comparatively new science of biochemistry is already indicating methods for increasing crop production which, if utilized, will enable the race to produce all the food material required for many generations to come.

In early times the subjects of soil fertility and plant growth were thought to be quite simple. It was held that plants derived all their nourishment from the humus of the soil, and this when exhausted was replenished by manuring with dung and other organic materials.

This "humus" theory was replaced about the middle of last century by Liebig's "mineral plant food" theory. He stated that plants obtain their carbon from carbonic acid in the air, and their necessary ash constituents from inorganic salts in the soil. Soil fertility could be maintained solely by the addition of

mineral fertilizers. This theory, with certain modifications, is generally accepted at the present time, and is seen stereotyped in the Fertilizers and Feeding Stuffs Act, where nitrogen, phosphates and potash are the only factors considered in a manure.

But during recent years evidence has been rapidly accumulating that the organic matter of the soil with its myriads of bacterial inhabitants is the most essential factor in soil fertility.

Organic matter, whether of animal or vegetable origin, when mixed with the soil undergoes decay, some portions rapidly, others slowly, resulting in the production of the dark material known as "humus." This material provides food and energy for numerous soil bacteria, and is gradually converted by them into substances suitable for plant food. These bacterial activities not only produce nitrates and other food substances, but they also render the mineral food constituents of the soil available for plants. Thus a "new humus" theory of soil fertility is gradually evolving as a result of modern research.

The parts played by the different kinds of bacteria found in the soil have been the subject of much investigation in recent years. Amongst these the nitrogen-fixing bacteria are perhaps the most important, for by their activities they can assimilate free nitrogen and add to the soil an increasing store of this essential element in a combined state.

The great discovery by Hellriegel and Wilfarth in 1886 of the relationship between leguminous plants and the "nodule" bacteria, and the demonstration by Beijerinck in 1888 that the bacteria in these root nodules can absorb gaseous nitrogen from the soil air and combine it with other elements into nitrogeneous food material was followed in 1900 by Nobbe and Hiltner's preparation of pure cultures of these "nodule" bacteria for soil inoculation. High hopes were entertained that soil inoculation for leguminous plants would result in greatly increased crops, and thus solve in part the problem of nitrogenous manuring. Unfortunately, these hopes failed of realization, for, although on certain poor soils inoculation has been attended with good results, it has to be admitted that on ordinary soils inoculation is useless for increasing the growth of leguminous plants.

In addition to the "nodule" organisms there are other nitrogen-fixing bacteria found in the soil, independent of any host plant. These live in the soil itself, and develop there even when no crop is growing upon it. The most important group of these free-nitrogen fixers is that discovered by Beijerinck in 1901, and named by him "Azotobactor." They are large ovoid forms, aerobic in habit—that is, they live only in the presence of air—and they are widely distributed in all fertile soils. Their power to fix atmospheric nitrogen is more pronounced than that of any of the other nitrogen fixers, and it has been stated that "Azotobacter, by its relative abundance indicates what may be termed the natural nitrogen-recuperative power of a soil."

Azotobacter can be cultivated quite easily in the laboratory in culture solutions containing sugar and the necessary mineral salts, but no nitrogen compounds; and it can be demonstrated by analysis that considerable quantities of atmospheric nitrogen have been fixed after ten to fifteen days' growth. Here again there was the prospect of utilizing these cultures for soil inoculation, and thus directly increasing the nitrogen content of the soil, but in spite of numerous experiments and attempts in this country, Germany and America, only negative results were obtained.

Recognizing the undoubted capacity which Azotobacter possesses to fix appreciable quantities of free nitrogen, it was felt that if only a suitable medium could be obtained it ought to be possible to introduce the organism into the soil with beneficial results, and it was with this object in view that a series of research experiments were commenced in the Botanical Laboratory, King's College, three years ago.

It was evident from the failures of previous investigators that a liquid medium was useless. The natural home of Azotobacter is not in a liquid but in soil, where in the presence of air it obtains its food and energy from the humus. Heinze, Krzemieniewski, and others had already shown that soluble soil humates exercise a remarkable stimulating action on the fixation of nitrogen by Azotobacter. Hence the problem was to find a medium rich in soluble humates. Numerous substances containing humus were tried, but all without success. Finally, experiments were made on peat. Naural peat is rich in humic acid, and it is well known that this humic acid can be converted into soluble humates by the action of alkalies such as potassium hydrate, sodium hydrate and ammonia. It was very soon evident, however, that peat treated with these chemical substances was useless for Azotobacter. The organism refused to grow in such a medium. Then, by a more or less happy chance, it was discovered that certain aerobic bacteria possess the power of converting natural peat into a "humated" neutral medium in which Azotobacter nourishes well if the "humating" bacteria are killed off by sterilization before the culture of Azotobacter is added. Hence the preparation of the treated or bacterized peat consists of three stages—first, the raw peat is moistened with a culture solution of the special "humating" bacteria, and the mass kept at a constant temperature for a week or ten days; during this time the bacteria act on certain organic constituents of the peat, and gradually convert a large amount of the humic acid present into soluble humates; second, the "humating" bacteria having done their work are destroyed by sterilizing the peat by live steam; third, the sterilized peat is treated with a mixed culture of nitrogen-fixing organisms—Azotobacter chroococcum and Bacillus radicicola—and after a few days' incubation at 26° C. is ready for use.

The following table shows the effect of the treatment as proved by analysis. Analyses of a garden soil and other manures are also given for comparison:

	Soluble Humate per cent.	Soluble Nitrogen per cent.	Total Nitrogen per cent.
Raw Peat	.028	.214	1.267
Bacterized Peat	15.194	2.694	4.310
Garden Soil	.012	.026	.427
Fresh Stable Manure	.433	.291	2.533
Well-rotted Stable Manure	1.46	.439	2.848
One-year-old Peat-Moss Litter Manure	1.05	.826	2.587

Ordinary soil when mixed with baxterized peat shows a striking increase in nitrogen content if the mixture be kept at the temperature most suitable for the growth of Azotobacter. In order to test how far this increase was due to the nitrogen-fiixing organisms introduced in the peat, two similar mixtures of garden soil and bacterized peat were made in the proportion of 9 ozs. of soil to 1 oz. of peat, the only different between the mixtures being that the peat in one was sterilized, thus killing off the nitrogen-fixers present. Each mixture was placed in a large bottle, and remained in an incubator for seventeen days at a temperature of 26° C. The contents were then analyzed, with the following results:

		Grm. N. per 100 grms. soil
Soil -|- sterilized bacterized peat	(a)	.717
	(b)	.709
Soil -|- active bacterized peat	(a)	.792
	(b)	.789

An average gain of 77 mgrms. of N. per 100 grms. of soil.

Another experiment with soil from Rothamsted gave—

		Grm. N. per 100 grms. soil
Soil -|- sterilized bacterized peat	(a)	.367
	(b)	.363
Soil -|- active bacterized peat	(a)	.421
	(b)	.417

An average gain of 54 mgrms. of N. per 100 grms. of soil.

As there was a possibility that sterilizing the peat before mixing it with the soil might result in a loss of nitrogen in the form of ammonia, a third test was carried out on a garden soil from Plumstead. An analysis was made of the mixture of active bacterized peat and soil at the commencement of incubation as well as at the end. This gave practically the same amount of nitrogen as the mixture with sterilized peat, thus indicating that the increase is due to the nitrogen-fixing organisms present. The results of analysis were as follows:

		Grm. N. per 100 grms. soil	Average
Soil -|- sterilized bacterized peat	(a)	.416	
	(b)	.417	.417
Soil -|- active bacterized peat	(a)	.419	
(at commencement)	(b)	.410	.415
Soil -|- active bacterized peat	(a)	.474	
(at end)	(b)	.476	.475

An average of 60 mgrms. of N. per 100 grms. of soil.

If this increase of nitrogen could be obtained throughout an acre of soil for a depth of three inches it would represent the equivalent of a dressing of 28 cwts. of nitrate of soda per acre, taking nitrate of soda to contain 15.6 per cent. of nitrogen.

This remarkable result has been described as "a new method of intensive culture—an intensive cultivation of the nitrogen-fixing bacteria in the soil—a "speeding-up" of nitrogen fixation."

Experiments at King's College on various pot plants soon demonstrated that bacterized peat, in addition to being an excellent medium for the growth and distribution of nitrogen-fixing bacteria, possessed special manurial properties of its own. In order to obtain a strictly impartial and extended test of the bacterized peat the authorities at Kew Gardens were approached last spring, and they very kindly arranged to make a series of experiments with a wide variety of plants. The plants selected were hipeastrum, begonia, streptosolon, asparagus, salvia, alternanthera, primula, carnation, pelargonium, fuchsia, and abutilon.

Twelve plants of each kind were selected by the curator, Mr. Watson, as being similar in size, age and health. They were then potted up in a series of threes in the following mixtures.

Series	Part bacterized peat		Part loam		Part sand
1	1	-|-	2	-|-	½
2	1	-|-	4	-|-	1
3	1	-|-	8	-|-	2
4	Loam, leaf mould and sand (ordinary potting compost).				

The plants were potted up on April 20th, and within ten days the effect of the peat was evident in increased growth and stronger development of the treated plants. This increase was maintained throughout the extent of the experiment, and in six week's time the treated plants were double to three times the size of the untreated ones. One very important fact demonstrated by the Kew experiments was that flower production and especially root development are promoted equally with increase of foliage.

At Chelsea Physic Garden a plot of radishes watered once only with an extract of the bacterized peat gave an increase by weight of 54 per cent. over the untreated plot.

Equally striking results were obtained on some experimental plots at Eton School Gardens by Mr. Machin, where the manurial effect of bacterized peat was compared with artificials and farmyard manure. The whole plot was 51 feet long by 36 feet wide. The plot was divided across its breadth into three equal portions of 15 feet each, and a smaller portion of 6 feet. This gave three lots of 60 square yards each, and a small plot of 24 square yards. These lots were treated as follows: Plot 1, complete artificial manure (top dressing), 4 ounces per square yard; Plot 2, (small plot), no manure; Plot 3, bacterized peat (top dressing), 9 ounces per square yard; Plot 4, one ton farmyard manure (half dug in subsoil, and half in top spit).

The rows of plants ran across each of these four plots. As each crop matured careful weights were taken, and are shown in the following table:

	Artificial		No Manure		Peat		Dung	
Potatoes—								
	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.
No. of Roots	42 25	7	18 8	9	40 42	10	43 32	4
Average	0	9.7	0	7.6	1	1	0	12
Turnips—								
No. of Roots	14 7	9	6 2	6	14 11	12	13 8	3
Average	0	8.6	0	6.3	0	12.7	0	10.1
Beets—								
No. of Roots	20 16	4	10 3	4.5	20 25	0	20 17	8.
Average	0	13	0	5.25	1	4	0	14
Onions—								
No. of Roots	61 6	2	37 3	10	60 12	10	58 8	8
Average	0	1.6	0	1.6	0	3.4	0	2.3
Carrots—								
No. of Roots	28 7	8	14 1	4	28 9	0	28 7	1
Average	0	4.3	0	1.4	0	5.1	0	4

The percentage increase of the produce from the peat-treated plots over those with no manure, artificials, and farm dung is as follows:

	No Manure	Artificials	Farm Dung
Potatoes	123	75	41
Turnips	100	47	26
Beets	281	54	43
Onions	110	110	46
Carrots	260	20	28

It will be noticed that in all cases the yields are small. This is accounted for by Mr. Machin in the following notes:

(1) Sandy soil over gravel. No manure for nine years, and had been continuously cropped with potatoes, followed by brassica.

(2) The previous season (1912) crops were a complete failure. Land as nearly exhausted as possible.

(3) The mixture of artificials used usually gives better results than dung, but owing to the exceptionally dry spring of 1913 the wet farmyard manure had an advantage.

(4) All the crops were much below the normal owing to (a) starved land; (b) exceptionally dry season on a hot, dry soil. Potatoes were all first earlies.

(5) The land was specially selected for testing food values on an exhausted soil.

The beneficial effects of bacterized peat as a top-dressing for grass has been noticed by several experimenters. The remarkable results obtained on the Mid-Surrey Golf Course are described as follows by the editor of the Garden writing in Country Life on November 1st, after inspecting the greens in company with Mr. Lees, the groundsman at Mid-Surrey: "The first to be dressed was a practice green, which, owing to the very hard wear to which it is subjected, and the fact that it is on sand, always gives a great deal of trouble, particularly in the autumn. This green was treated on August 28th, and at that time was in a very worn condition. Now (November 1st) it is as perfect as a green could be, the turf being very close and hard and of a particularly healthy color. Near to this practice green, and also on sand, is an undulating green that Lees assured me has always been a worry to him at this season. This, when dressed with the prepared peat a little more than a fortnight ago, was very brown in places, but now the brown patches have almost disappeared, and the turf is very healthy and of excellent substance. A third green, also of an undulating character, was treated on Tuesday of last week, and three days later was showing signs of improvement. After experimenting with different quantities to ascertain the proper amount to use—2 ozs., 4 ozs., 10 ozs., and 12 ozs., per square yard respectively—Lees has come to the conclusion that 3 ozs. per square yard produces the most satisfactory results. This is applied in a pulverized state as a top-dressing, and for the first few days seems to open up the soil and to let the grass through, after which this slight sponginess disappears. Not only have these dressings had a most remarkable effect on the blades of the grasses, but root-growth has also been increased to a very considerable extent."

The question has been raised as to whether the results obtained are due to nitrogen-fixation directly or to a more general manurial effect. Probably both are important.

Recent experiments, however, indicate the probability of the presence of another factor. Mr. Watson, in the Kew experiments, noticed that a small amount of bacterized peat often gave as good results as a heavy dressing. This was most evident when the soil treated contained plenty of available plant food. In an experiment with Richardias, potted up in heavily manured soil, he found that a top-dressing of about half an ounce of peat to a 10-in. pot doubled the

weight of the treated plants in a month's time. Dr. Rosenheim, of King's College, obtained equally striking results on Primula malacoides by treating twice only with the water extract of 0.18 of a gram (1/150th of an ounce) of bacterized peat.

Such effects cannot be due to the small amount of direct food material present in the peat or its extract added to the soil, and it was realized that in the prepared peat there is something which has the effect of stimulating and promoting growth in an extraordinary manner. Numerous experiments now in progress indicate that this "something" is probably similar in nature, Dr. Rosenheim suggested, to the accessory food bodies recently found to play such an important part in animal growth and nutrition. If this is confirmed it will go far towards explaining the specific action of bacterized peat as a fertilizer.

DISCUSSION.

The Chairman, (Professor Frederick Keeble, F.R.S.) referred to the general bearings of the lecturer's theme. It was impossible to avoid being struck by the peculiar position of agriculture in the present day, a position which might be likened to that of Portia in "The Merchant of Venice," who was beset by several suitors bearing caskets in their hands. The agriculturist and horticulturist were told by the biologist that they must apply themselves to a study of bacteria; by the chemist, that their wealth was dependent upon securing the right kind of fertilizer. Now, it was the physiologist who proposed to show people engaged in agriculture or horticulture how they were to get rich. Some sympathy was certainly due to the practical men who had to meet these various suggestions for the acquisition of wealth. Nevertheless, he considered that if Professor Bottomley could establish the case he had developed there were riches to be obtained. He would put it that Professor Bottomley was able to take material of small commercial value, used mainly for the making of coal and oil, and extract from it not only the humates in a form in which they could be used for plants, but also to use these humates as a seed-bed in which the Azotobacter or nitrogen-fixing organism could thrive. If more extended trials than those so far undertaken could establish that Professor Bottomley could do those two things he would have earned the encomium of Swift for those who made two blades of grass grow where one grew before. To the speaker the subject was not, perhaps, most attractive on its commercial side; it was most interesting from the point of view of the intricate chemical and biological considerations involved. There were, indeed, many questions he would have liked to have put to the Professor, particularly about the preliminary stages of his process. He had not yet learned the details of the bacterium which did the work of humating, nor did he yet understand why the chemical production of humates should not serve as a nidus for the Azotobacter. On these two points it was important to have information. The point

the author had raised about the influence of the peat on eel worm was of particular interest although not surprising. Practical gardeners were well aware that an excess of nitrogen manure was a great encouragement to disease. On the other hand, it has been established that a certain amount of nitrogen was good for getting rid of mildews. Traces of other substances, such as lithium salts, were said to be of great value in preventing disease. The speaker had been struck by Professor Bottomley's development of the last part of his thesis, respecting accessory food bodies. In France reports of experiments, published every six years, alternately confirmed and disproved the effect of exceeding minute traces of most unlikely substances on plant growth. It had been shown many years ago that if zinc, to an amount so small as to be expressed in the fourth place of decimals, were applied in the culture of certain moulds the latter developed at a pace equal to sixteen times that of their former rate of growth. Zinc, therefore, must almost be regarded as an accessory food body. It was at all events a stimulator. Of these stimulators there were so many as to tempt to the belief that plants, like most living things, required change. It was notorious that plants grown for any length of time on the same ground grew badly. It was, the speaker argued, quite unnecessary to seek evidence of the bona fides of the lecturer's experiments, inasmuch as the latter had been carried out by the Curator of Kew, Mr. Watson, and his assistants. He was himself convinced from the first of the efficacy of the material discussed, particularly on seeing the remarkable series of plants which Mr. Watson had grown at Kew. Bacterized peat had appealed to his imagination in connection with the Irish problem, towards a solution of which a bacterized peat industry in Ireland, which would convert the peat bogs into smiling potato fields, might go far.

Dr. J. A. Voelcker had followed with much interest the descriptions given, and, like the Chairman, accepted the demonstration in good faith; but, like him also, he desired further explanation, particularly as he proposed to carry out experiments himself. On the question of the amount of nitrogen, Professor Bottomley had stated that he had proved that the increase of growth could not be wholly accounted for by the nitrogen added, and he had shown that in many cases a smaller amount gave better results than a larger one. That was well understood in agriculture; an overdose of nitrogen might lead to results infinitely inferior to those which would follow the application of the precise amount which the plant could take up without injury. The nitrogen question was unsettled, as, apparently, some experiments had shown that an increase in crop was not greater than might be accounted for by the nitrogen added. As Professor Bottomley had presented the matter, it seemed that the nitrogen plus the accessory food body worked in a way that was quite unfamiliar to agriculturists or horticulturists. For instance, it answered equally well for any kind of plant, potatoes, cabbages, or what not. Nitrogen, he would allow, did not behave quite

in that way. It would seem that the application of this peat would be found beneficial even in the case of golf-greens; this was somewhat surprising, inasmuch as it was recognized that the tendency of nitrogenous manuring was to produce coarse, rank grass, and not the fine herbage which the golfer desired. While prepared to accept bacterized peat from a horticultural standpoint, he was not sure that it would be applicable to agriculture on a large scale. The author had shown that in the treated peat there was some 4 per cent. of nitrogen which was relatively a great quantity and should go a long way. Moreover, it appeared to the speaker extraordinary that in view of the antiquity of agriculture and the long study of the growth of plants under different conditions the value of these accessory substances had not been noted earlier. He could not see that there was anything to show that an observed increased in the growth of different crops could not be accounted for by the work of such well-known materials as nitrogen, potash, phosphates, etc.; there was no evidence to show the need of accessory substances which played a part in the cultivation of the plant. Finally, he would say that, from a practical point of view, the question of cost was paramount. Was there any likelihood of the material being put on the market in an accessible form? It might be too early to put such a question, but he was induced to ask the question when he remembered that Professor Bottomley had indicated, on one diagram exhibited, that one and a half tons per acre would be needed.

Mr. J. Coutts observed that at Kew they had found that much peat added to the soil generally proved detrimental to the growth of monocotyledons; better results were obtained with the smaller doses. The attitude of the experimenters at Kew was, he might mention, quite skeptical; they had suffered from the "plant doctor," although the errors of the latter were doubtless due to his inexperience and ignorance in applying his materials. So far as the bona fides was concerned, the work done was supervised by Mr. Watson himself, who, assisted by the speaker, mixed the materials for each individual plant; the plants, beyond ordinary details, had no special attention during growth other than that devoted to starting them; after a fortnight or so they were left to themselves. The results in some cases were extraordinary, and not comparable with those obtained from ordinary nitrogenous manure. Experiments had been made to determine whether peat afforded plants a greater power of resisting the eel worm, and in this connection the carnations showed the most striking results. In the case of the peat-treated plants there was little trace of eel worm after two months' growth, whereas the nitrated plants were badly affected within a fortnight. Another experiment was made with chrysanthemum plants in the open, planted at the same time and under the same conditions. One section of this planting was treated with 2 ozs. of peat to the square yard, and a second with 4 ozs., while a third section was treated with dried sewage sludge, and a fourth with nitrates.

The differences in results were marked. The section treated with the smaller quantity of peat seemed as good as that which had received a larger allowance. Again, the sludge section was considerably superior to that which was nitrated, although much inferior to the peat-treated sections, the action being slower. It was evident that there was something in the nature of manurial effects in the peat, the root development of the plants being very marked.

Mr. A. Machin referred to certain experiments which had been carried out with bacterized peat. A quantity of peas had been sprinkled with the peat, and other plants had received treatment with nitrates. From the peat-treated peas 28 lbs. of dry seed were obtainable; from the nitrated plants 18 lbs. Another experiment, had been made with tomatoes grown for seed in houses. In this case peat was used for some of the plants and for others yellow loam mixed with rotten dung, and the peat-treated plants gave the better results, notwithstanding that they received nothing but pure water, while the other plants were fed every three days with a special artificial fertilizer. If there were no potash in the peat the plants nevertheless obtained it in some way or another, as it was impossible for fruit-producing plants to do without potash. The conclusion the speaker therefore had come to was that the peat strengthened the plants by enabling them to secrete in their roots the power to increase the phosphates and potash in the soil. He knew of a grower of plants who was keenly interested in securing the prepared peat, as he had found that he could, with peat, raise a plant in two months ready for sale, which, without the peat, required six months for its development. This man was at the present time buying small plants in Holland and Belgium, and tehse plants he was treating with a simple top dressing of peat, about a spoonful to each plant. In the result the time taken by the plants to develop was two months less than when grown without peat. With this peat, also, he could obtain geraniums by May or June, selling them at 4s. a dozen, whereas under former conditions he obtained only 2s. 6d. per dozen. The question of price was, the speaker considered, of small consequence when regard was had to the unique properties of the material. A grower who intended to exhibit was compelled to secure the best possible results and must have the best stimulators. On the other hand if, as had been suggested, a small quantity would serve as well as a large one, so much the better for the user.

Dr. O. Rosenheim (King's College, London), believed that the audience would agree with the last speaker that bacterized peat was a substance having remarkable properties as a stimulant to growth. He had carried out a few experiments for the purpose of investigating the minimum quantity of the peat which would produce the results which Professor Bottomley had shown; the quantity proved to be very small indeed. The speaker had found, on actual analysis, that a solution prepared from the peat, containing only about 30 milligrams of solid substances, produced striking results on plant growth. His

results showed that the effect of peat was out of all proportion to what would be expected from an equal weight of a mere manurial substance. The amount of nitrogen in it could not supply the needs of the plant, and that remark was equally applicable to the amount of phosphates, etc., present. There appeared to be some fundamentally new substance at work, a substance which was at the bottom of plant growth. It had struck him that the active principal in prepared peat had some analogy to a newly-discovered factor of animal nutrition, which is still in its infancy. It was already evident that the old idea that animal and human food consists of proteins, carbohydrates, fats, and salts alone must be abandoned. In America, in England and elsewhere, it had been experimentally shown that in order to support life something additional was required. The animal could obtain the necessary additional matter only from plants, and the next question that arose was, whence did the plant itself obtain that substance? He believed that, directly or indirectly, the plant obtained what it required from the humus, and that in the peat as prepared by Professor Bottomley the essential substance for growth was present. Of course it was advisable to be very cautious in bringing forward such a clue, but the experiments so far carried out seemed to support it. A substance of the type indicated had quite different properties from those of the well-known manures; it was soluble in alcohol, which distinguished it from the substances customarily dealt with in plant nutrition. So far no substance soluble in alcohol was known which could produce such an effect when used in such minute quantities. He believed therefore that Professor Bottomley's bacterized peat contained in relatively large quantities a substance of fundamental importance.

Mr. W. T. Chadwin referred to a paper recently read before the Society, dealing with the electrification of vegetable life, and with radio-active residues, a scheme which, to his mind, presented several practical drawbacks, however great might be its scientific interest. His difficulty had been to understand how the farmer was to apply it, so minute was the amount of radio-active soil to be dealt with, and in addition he had anticipated difficulties in relation to the 2,000 years it was supposed to last. The material which Professor Bottomley had submitted was interesting to the speaker in view of his connection with the Central Chamber of Agriculture. Here again, the practical aspect was the significant thing. If Professor Bottomley could do anything to increase the productivity of the soil nothing could be more desirable. But he (the speaker) was at once confronted with the question of cost. If the amount required per acre could reach the magnitude of one and a half tons, he would like, if not too early, to realize the probable cost of the material, and also its durability.

Mr. E. Colman desired to ask the author whether the peat preparation would be affected to any extent by a dry season; whether moisture was necessary to promote the cultivation of the bacilli referred to.

Mr. E. H. Sams asked the author why he had selected for his experiments plants known to require nitrogenous food. The plants exhibited were known to feed almost wholly on nitrogen, and did not need phosphates, and therefore their selection was not a fair criterion of the value of bacterized peat. Such plants responded rapidly to applications of organic manure. Further, he would inquire why sample of food-producing plants were not submitted. Experience had taught the effect of chemical fertilizers, but with regard to the prepared peat it seemed advisable to look further ahead and inquire into the cause of the results obtained. For plant food, those inert materials of the soil should be taken up which were convertible; stimulation of plant growth would quickly lead to exhaustion of the fertility of the soil, unless the peat could be supplied in good quantity, whereby the humus required by the soil would remain. Otherwise, the position would not be better than in the case of the chemical manures which put back into the soil that which the plants took up.

Mr. E. F. Hawkes asked Professor Bottomley whether water was added to the raw peat exhibited on the table, and was informed that no water was added; the only moisture present was that which had not originally dried out. The speaker was interested in the point, because some years ago he had used peat, finely broken up and moistened, for growing young sugar-cane cuttings. The heat employed was 75°, and the canes commenced growing very rapidly, so fast, indeed, that he used a proportion of pure peat moss with the soil; the plants grew very much quicker than in ordinary soil. The paper itself and the course of the discussion led the speaker to believe that possibly, in finding the most suitable culture media for nitrogen, Professor Bottomley had also found the most suitable media for potash and the phosphates. It might have the same effect in speeding up the latter foods in the soil as it had in the case of the nitrogen.

Mr. A. Hall referred to his experience in trying peat and sand as a medium for diseased plants, with unsatisfactory results, due doubtless to lack of experience. He had tried ericas in prepared peat, but all the plants had died; that, however, might have resulted from bad treatment.

The chairman, referring to the remark that there was something peculiar about the plants chosen, and that they took only nitrogen, desired to observe that the plants required just the same foods as other plants; it was merely a question of relative amounts.

Professor Bottomley replied very briefly to one or two questions. In the bacterial treatment of the raw peat with a chemical, it was impracticable to get the accessory food body precipitated by phospho-tungstic acid—the ordinary method of acid, or whether it was produced by the breaking down of some of the organic decomposition products already in the peat, were questions for further investigation. His main point was that chemical treatment did not yield the results obtained by bacterial treatment. He could not say what bacterized peat would cost, nor would it be possible to estimate the cost until more was known about the peat.

THE PEAT-MAKING INDUSTRY OF NORTHERN HOLLAND.

(U. S. Consular Report).

Peat fuel is made in Holland from two sorts of ground, the Sphagnum peat beds being found on the moorlands, while the sedge and grass peat beds are situated in marshy bogs. The peat of the country is formed from decayed vegetable matter, such as mosses, grass, heather and various other sorts of plants. The grass peat bogs extend to a depth so far beneath the normal ground water level that it is necessary to drain the water off by ditches. The Sphagnum bogs are above the normal water level of the canals.

Beginning of the Turf-Making Industry. Just as food, clothing and lodging are necessary, especially in a climate like that of Holland, the obtaining of fuel is also an important matter. It is quite certain that the earliest inhabitants of the country from remote times had to burn peat, especially in those sections of the country where no wood was to be had. The peat industry here, therefore, dates from many centuries ago. In the neighborhood of cities and villages, the industry grew more rapidly than in country districts on account of the greater demand and small cost of transportation. Later, waterways were made to reach the more distant peat beds.

Peat Bogs and Short-Peat. Out of the peat bogs short peat was obtained, also known as "sponturf." The process of excavating the peat is about as follows: To begin with, a small stretch of ground is necessary on which to spread the peat so that it will dry. When this area of ground has been leveled off and a layer of straw spread over it, the digger can begin his work. With a spade he forms the loose, wet peat into square, flat pieces. When the peat is well mixed, it is taken out of the basin and laid on the straw-covered ground, which absorbs the superfluous water. The sheet, when sufficiently dried, is cut with a knife or sort of spade into blocks about the size of an ordinary brick. When sufficiently sun-dried, the blocks are stacked into piles. Later the blocks are piled into larger stacks. In this manner the peat is changed around till that which was at the bottom of the original piles is on top of the stack. The stacking of peat is done usually by women. The wet peat is laid in long rows flat on the ground, so that in a short time the sun has sufficiently dried it to form a hard crust on the upper side. Then another row is laid on top of the first, and when this is dried, another, and so on, till 11 rows have been laid. It is so piled up that the wind circulates freely around each piece.

The time for digging the peat is from March 25th till the end of June. The lighter sorts are made during the whole year. The owners of peat fields erect houses which are rented to the workmen and their families. In many instances

a plot of ground goes with each house, which enables the workman to dig and dry his own peat free of cost. The wages of workmen who cut the peat range from 2 to 3 guldens ($0.80 to $1.20) per day, while the women are paid from 25 to 32 American cents per day. During the cutting season many workmen from neighboring districts are employed.

Yearly Turf Production of This District. The yearly production of peat in the different Provinces of this consular district is about 1,700 million blocks, divided as follows: Drente, 1,200 million blocks, Overysel, 300 million blocks, other provinces combined, 200 million blocks.

Machines are very little used in the preparation of short peat. In the peat bogs of North Holland machines are here and there used for pulping and kneading. In some parts of the country the peat bogs are often rented to the workmen or contractors. When this is the case, the owner retains possession of the land after the peat has been removed. These peat fields can not be worked without first obtaining a concession from the Government. A certain sum must also be paid for the building and maintenance of the dikes around the polders. In Friesland the owners of ground, where short peat is produced, are obliged to make a deposit in money. After the peat has been removed and the ground brought under cultivation the amount of the deposit is returned to the owner.

Yearly Production of "Short Turf." The total yearly production of "short turf" in this section of Holland is about 700 million bricks or blocks. Drente produced 150 million, Overysel 120 million, North Holland 200 million, other provinces combined 230 million. The value of this peat in the bog is about $600,000. Here and there peat is dug for private use. The total annual production of both long and short peat in this district is valued at about $3,000,000 in the field.

Use of Peat as a Fuel. Besides what is consumed for household purposes, the amount used in factories is not unimportant. In brick factories situated along rivers large quantities are used as fuel. In strawboard and potato-flour factories, especially those situated in the northern part of the country, it is used in great quantities. Large quantities of heavy peat are also shipped from Drente to Friesland and the northern cities. Light peat is also shipped in great quantities to Amsterdam and The Hague, where it is extensively used for lighting fires.

Moss Litter. In some peat fields, the upper layer of peat to a depth of one-half to one and a half yards, is of a light brown color. This peat is very porous and light in weight. Seen from the outside it looks like great square sponges. From this sort of peat, known as "bolsterturf," peat dust, which is shipped to all parts of the world, is produced. After being ground, it is packed in 200-pound bales. Peat dust is much used for bedding in stables. When used for

that purpose its absorbing qualities are such that it make an excellent fertilizer. It is also extensively used in nurseries. Peat dust factories are to be found in Klazinaveen, Hoogeveen, Beilen, Dedemsvaart, Friezenveen and Bergentheim.

The yearly production of peat dust in Holland amounts to 200,000 tons. In Germany the railways allow a discount of 30 per cent on the transportation charges, but as this does not apply to shipments from Holland, the Dutch shippers are unable to compete with Germany in that country.

Use of Machinery. On the border of the Province of Groningen the use of peat-making machines is rapidly growing. In the neighborhood of Emmercompascuum some 50 machines have been introduced. These are used only for macerating the peat. The wet mass is spread out on the field and worked the same as "short turf." In Hoogeveen and Vroomshoop there are factories where machinery is also used.

The undeveloped districts in which peat is found occupy but a small portion of the waste land of the whole country. There are yet about 35,250 hectares which are still undeveloped. In the Province of Drente alone there still remain about 21,340 hectares (hectare equals 2.47 acres) which have not been touched. It must not be forgotten either that each year there are about 10,000 families who find employment in the peat fields. Thousands of workmen also find employment in sanding the land and preparing it for cultivation after the peat has been removed.

By the judicious use of artificial fertilizers such ground is soon brought into a high state of cultivation. The excavations caused by the removal of the peat are called valleys and are very fertile. As soon as these valleys are ready to be worked they are taken possession of by the farmers.

As soon as the growing of grain and the raising of potatoes is sufficiently developed, factories for the manufacture of strawboard and potato flour are established, and thus in a few years thriving communities spring up where formerly all was waste land. Many prosperous towns and cities, such as Veendam, Wildervank, Oude and Nieuwe Pekela, Nieuw-Buinen, Stadskanaal, Emmercompascuum, Klazinaveen, Erica, Nieuw Amsterdam, Dedemsvaart, Hoogeveen, etc., owe their existence and prosperity to the peat industry.

Advantages of the Peat Industry to Inland Shipping. By using the canals for the transportation of peat, hundreds of boatmen and their families find a means of livelihood. Aside from a certain amount of freight which is shipped by rail, there are yearly between 5,000,000 and 6,000,000 cubic meters (cubic meter equals 35.314 cubic feet) of boat space necessary. When one takes into consideration the fact that these boats have a capacity of from 50 to 250 cubic meters, some idea of the extent of the industry may be formed when it is stated that about 48,000 boatloads are shipped yearly.

THE PUMPING OF PEAT

(Journal of the American Peat Society).

We now have records of at least four well planned and executed experiments on excavating peat from the bog and delivering it to drying grounds by the use of pumps of the centrifugal type. Two of these have been mentioned before in this journal. First, the operations of Lakeville, Indiana, at which the peat was excavated and pumped into tanks by a centrifugal pump; second, the work of the Farmers' Farm Company at their plant at Plymouth, Ohio, where a 12-inch suction dredge was installed and operated to excavate peat for filler and deliver it at the drying grounds for part of the season of 1912 with entire satisfaction. In the past year, reports have been received of two other places at which this method of excavating and delivering peat has been tried experimentally with success.

There seems to be no question, therefore, that this method of producing and conveying peat pulp is a practicable one for making peat fuel in large quantities, especially at undrained bogs or those which are undrainable. The method apparently requires, with the ordinary forms of centrifugal pumps used on suction dredges, that the peat be diluted with water. It is probable also that with the ordinary forms of equipment used in digging and pumping sand and other mineral soils, the apparatus will have to be somewhat modified for getting best results in excavating peat.

With some types of peat the extra water which has to be pumped with the peat separated from it very quickly, as the peat settles from the water in a short time. The water then may be allowed to run off through properly provided channels from the surface of the settled peat pulp, after which the sheet of peat may be marked as when spread by machine.

If the peat is handled in this way and can be handled commercially for the production of peat fuel, it is easily demonstrable that the pulp, to which the peat is reduced by the excavating machine, and its passage through the pump itself, is much more finely ground than the material produced by the ordinary macerating machine of the pugmill type. This complete maceration is an advantage in spreading the wet peat pulp and in producing exceptionally fine grained bricks which when dry should be tough and hard and of comparatively high density.

It seems probable that the thickness to which the peat should be spread on the drying beds will be somewhat variable as with the usual macerating machine, according to the climatic and other conditions of the locality in which the drying is to be done, but, on the whole, it would seem that the beds would have to be a

little thicker than with machine peat and should be spread about 5 to 7 inches thick, according to the amount of water.

The marking off into bricks would be done in the same way as where the peat is spread with the usual type of field press, such as that which has been in use in Canada at Alfred and Farnham.

In order to keep the very fluid peat from spreading too far on the drying beds, some form of retaining structure around the beds will probably have to be maintained. This can be made movable and can be quickly and cheaply made by using boards of ordinary cheap lumber. The boards under most conditions probably need not be more than 8 inches wide with the most fluid peat. By arranging the delivery pipes at proper intervals, to be determined by the nature and layout of the drying grounds and the frequency with which the beds are to be alternated, it will be entirely possible to have a permanent ground adapted to the requirements of the business which is to be developed.

This plan of handling peat for fuel production presents many attractive features to those who wish to utilize peat below a permanent ground-water level and which could not readily be utilized by any of the types of peat machines of large capacity which are now on the market. It is hoped that before long this method may be given a thorough trial on a commercial scale, as it seems entirely practicable.

PEAT LITTER AND MULL FOR HEN HOUSES.

(Journal of the American Peat Society).

Peat litter and mull have been recently tried out for use in poultry houses in this country, with reported excellent results. These seems no reason why this material should not be satisfactory for scratching sheds and for use under the roosts, on the roosting platforms of the winter quarters of all kinds of farm poultry. It is ideal for use in brooders and for the quarters of young chickens. The only present difficulty in the way of extending the use of this material is its high cost in single bale lots as compared with straw and similar material which it might displace if it could be sold at a lower price. But in spite of the necessary high price, a considerable amount of the material is being used by poultry men and reports from various sources seem to indicate that it gives entire satisfaction to those who have tried it.

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"If ever there was a time when a nation needs to bend every effort towards the proper utilization of the natural wealth on which prosperity depends it is our country, and the time is the immediate present."—*Pulp and Paper Magazine.*

THE BACTERIAL TREATMENT OF PEAT.

We are enabled to publish in the present issue of the Journal a full report of a paper recently read before the Royal Society of Arts by Professor Bottomley of King's College, London, England, on the new bacterial treatment of peat, which promises to be of great interest to agriculturists throughout the world. The results of numerous experiments conducted at Kew Gardens under the direction of the Curator, Mr. Watson, and at other places in England, would appear to afford a strong demonstration of the value of the new fertilizer produced by this method.

Especially striking is the fact that very small quantities appear to have produced good results. Thus in the experiments recorded at Eton School Gardens 9 oz. per square yard of bacterized peat used as a top dressing on a worn out soil is reported to have given results averaging nearly 40 per cent. higher than that obtained from 37 lbs. of farmyard manure to the square yard, half dug in subsoil and half in top spit. Uniformly favorable results seem to have obtained in the case of a number of root crops, and trials on grass on the Mid-Surrey Golf Course also resulted favorably. Experiments with 2 oz., 3 oz., 4 oz., 10 oz., and 12 oz. to the square yard were made and led to the conclusion that on the golf course at least, 3 oz. per square yard produced the most satisfactory results.

The effects of so small amounts of bacterized peat can hardly be attributed to the amount of direct food material present in the peat and are not altogether accounted for. In the interesting discussion which followed the reading of Prof. Bottomley's paper, it was pointed out that the practical value of the new fertilizer would depend entirely upon the cost of its application and the durability of its results. No definite information on either of these points was offered.

Further reports of Prof. Bottomley's process of treating peat will be awaited with great interest, and if it can be brought into general use with satisfactory economic results, the discovery may prove of importance to Canadian farmers and gardeners.

WORLD'S USE OF ARTIFICIAL FERTILIZERS.

It is estimated that the following quantities of artificial fertilizers were manufactured and sold to farmers throughout the world in 1911:—

	Tons
Superphosphate of lime	10,000,000
Rock phosphates	6,000,000
Basic slag	4,000,000
Guano	66,000
Potash manures	1,200,000
Nitrate of soda, sulphate of ammonia, nitrate of lime and nitrolin	4,000,000

The deposits of nitrate of soda in South America are, says the *Smallholder*, becoming gradually exhausted, but science has seen to it that the farmer shall never be in want of supplies of nitrogenous manure. Sulphate of ammonia is a by-product in the manufacture of gas, and is now also produced from peat. Nitrate of lime and nitrolin contain nitrogen which has been obtained from the air, where it is present in inexhaustible quantities. A new source for potash manures has been found in marine algae, and the process of manufacture is chiefly carried on in the United States. It is stated that Americans anticipate no difficulty in obtaining an annual supply of at least 1,000,000 tons of potassium chloride.

A new process of dealing with felspar promises a further supply of 400,000 tons of potash. The largest users of artificial manures, grouped according to their food-producing capacity, are:—Belgium and Luxemburg; Germany, Holland and Denmark; and France, England, Australia, Italy, and Switzerland. Germany uses about 1 cwt. for every acre of agricultural land.

—*Weekly Report, Department of Trade and Commerce.*

DISCUSSION IN HOUSE OF COMMONS.

On March 18th, when the estimates of the Minister of Mines were being considered, a discussion arose in the House of Commons on the peat fuel investigations conducted under the direction of Dr. Haanel at Alfred, Ont. Members of the House who took part in the discussion displayed a lamentable lack of knowledge with regard to what has actually been done and is being done in Canada along this line, and it is sincerely to be hoped that our representatives in Parliament will take every opportunity of becoming better acquainted with the present condition and the potentialities of the peat industry.

Hon. Geo. P. Graham (South Renfrew) introduced the subject as follows:—

"What progress has been made in experimenting with the manufacture of peat? Some years ago I took quite a little interest in the manufacture of peat into a marketable commodity for fuel. Having come very close, however, to some people who have invested in plants for the manufacture of peat, I have now become a doubting Thomas regarding it. Experiments have been carried on for some years, but I have yet to learn that a method has been discovered by which the peat in our peat bogs can be converted into marketable briquettes. No real advance has been made. I have seen tests made of the briquettes; they burn nicely and give out a fine heat, but they have been only a spasmodic success, and have been manufactured in small quantities. Can the minister tell us if the people of Canada may expect our great peat bogs to be utilized in a practical manner? We have a sufficient amount of peat in the Dominion of Canada to protect us from all the coal barons in the world, if the Government has solved the problem how to manufacture peat. If I remember aright, the great difficulty was in getting rid of the moisture in the raw material. Another difficulty was that the briquettes though they looked very inviting at first, and produced the desired result, disintegrated in a very short time, leaving very little behind but a few shovelfuls of mother earth."

Mr. Graham spoke throughout of briquettes, and did not seem to be aware that the air-drying process successfully demonstrated by the Mines Branch at Alfred, and now in commercial operation has nothing to do with the manufacture of briquettes. His remarks apparently had reference to unsuccessful operations several years ago at Brockville, Ont. A Dickson briquette press was installed there and several thousand dollars were expended on buildings, machinery, plant, drainage, etc., with no practical results. The peat was gathered by harrowing the surface of the bog. The loose peat thus exposed was quickly dried by the sun, and a thin surface layer removed containing from 50 to 60 per cent. moisture. For the operation of the briquette press, however, it was necessary to further dry the peat to a moisture content of about 10 per cent. The problem of accomplishing this further drying economically by artificial heat was not solved, and the operations were a failure. The further difficulty was experienced that the briquettes made by the Dickson press disintegrated in a short time on exposure to moist air as stated by Mr. Graham.

This was one of the failures which led Dr. Haanel to advocate the testing under Canadian conditions of the air-drying process of making machine peat carried on so extensively in Europe, and which is now being conducted in Canada with improved machinery devised to offset the higher price of hand labor in this country, but involving no theoretical change whatever from the most advanced European practice.

Mr. Nesbitt (North Oxford) followed with the suggestion that the government should look into the process employed by Dr. McWilliam at London, Ont., and further said:—

"In Russia they are able to recover peat on a commercial basis and sell it against coal or wood in very large quantities; but the process is by hydraulic pressure. I have a sample of the Russian peat at home, and it is superior to anything I have seen made in Canada, although I have seen peat from the various Canadian peat bogs, made by the Department and by others who have been trying to manufacture it. Why should not the Government look into the Russian process? We have enormous peat bogs all through the country. If we could manufacture peat on a commercial basis, there is no reason why we should not supply our people with this class of fuel. It is a success if it is properly manufactured. Peat produced by the air-dried process pulverizes and is no good."

If Mr. Nesbitt had been conversant with the subject, he would have known that most of the peat fuel made in Russia, amounting to some millions of tons yearly, is manufactured by the very same process and practically the same machines as were successfully used by the Mines Branch in the operations at Alfred, Ont. The report of Erik Nystrom, who was sent to Europe in 1908 to investigate conditions there shewed that over 1300 Anrep plants were then in use in Russia. He reported moreover that the air-drying process was the only one which had proven commercial in Europe, and on his recommendation the Anrep plant at Alfred was installed.

The statement that the Russian peat is made by hydraulic pressure is altogether erroneous, the process being the same identically as that employed at Alfred, Ont. So far as we are aware there is nowhere in successful commercial operation a peat plant depending on hydraulic pressure to remove the water from peat.

Mr. Nesbitt's recommendation to the government was made therefore just six years after they had conducted the investigation he asked for.

The statement that air-dried peat pulverizes was also clearly based on a misconception, the speaker probably having in mind the same sort of peat briquettes referred to by Hon. Geo. Graham.

The process employed by Dr. McWilliam has also been already investigated by the government. Full details of his operations have been published in the Journal of the American Peat Society in a paper contributed by him at one of the annual meetings of the Society. He harrows the surface of the bog, just as was done at Brockville several years ago. Further moisture is removed by artificial drying and the peat dust then compressed into briquettes. Dr. McWilliam has been experimenting with various driers, presses, etc., for the past fifteen years, and so far as can be learned has not yet reached the stage of commercial production.

Hon. Chas. Murphy (Russell) said he was informed that $100,000 had been expended and that the result had been a complete failure.

Hon. L. Coderre, Minister of Mines, stated in reply that the total expenditures at Alfred, before as well as since he took office were $25,508.98.

The fact that the manufacturing of peat fuel in Canada by the process introduced and demonstrated at Alfred by the government has been continued by private parties, who have taken over the government bog, is sufficient evidence that Mr. Murphy was misinformed.

It was further stated by the Minister that Dr. Haanel had reported that he could not recommend further expenditures by the government at present because he had found that peat fuel could be turned out commercially in Canada by the air-drying process.

PEAT FUEL AND THE SMOKE NUISANCE.

While good machine peat fuel is comparable to soft coal in available calorific value, it has the substantial advantage of being practically smokeless. The combustion of peat burned under ordinary conditions being more perfect than that of soft coal, the comparative B.T.U. per pound do not afford a fair test of the comparative value of the two fuels. In the case of soft coal the loss up stack, and the loss in the ash pit due to unburned fuel in the refuse are both much greater than with peat fuel. So great has been the public misapprehension of the problems involved, that chimneys belching forth great volumes of black smoke have been regarded as a sign of prosperity. It is coming to be realized that smoke stands for nothing but gross economic waste. The losses and injury due to smoke have become so important as to engage wide attention during the past few years. In Germany and Finland, societies have been formed to study the problem of smoke abatement, the Hamburg Society formed in 1902 having now 473 members. The health authorities of twenty English cities and towns have agreed to join in the work of recording the character and amount of atmospheric impurity.

In the United States, under the auspices of the Mellon Institute of Industrial Research connected with the University of Pittsburgh, a staff of twenty-five specialists has been for some time engaged in investigating the smoke nuisance, and several important bulletins have appeared, viz.:—

1. Outline of the Smoke Investigation.
2. Bibliography of Smoke and Smoke Prevention, by Elwood H. McClelland.

3. Psychological aspects of the Problem of Atmospheric Smoke Pollution, by J. E. Wallace Wallin, Ph.D.

4. The Economic Cost of the Smoke Nuisance to Pittsburgh, by John J. O'Connor, Jr., A.B.

5. The Meteorological Aspect of the Smoke Problem by Herbert H. Kimball, Ph.D.

6. The Effect of Smoke on Building Materials, by Raymon C. Brennan, Ph.D.

7. The Effect of the Soot in Smoke on Vegetation, by J. F. Clevenger, M.A.

8. Some Engineering Phases of Pittsburgh's Smoke Problem.

The following are a few excerpts from the bulletins mentioned:—

"It has been estimated that the smoke nuisance costs Cleveland $6,000,000; Cincinnati, $8,000,000, and Chicago $50,000,000 per annum. Herbert W. Wilson of the United States Geological Survey is authority for the statement that the country as a whole suffers a loss of over $500,000,000 each year, in damage done to merchandise, defacement of buildings, tarnishing of metals, injury to human life and plant life, the greatly increased labor and cost of housekeeping, and the losses of manufacturers due to imperfect combustion of coal."

Wilson's estimate included $90,000,000 due to imperfect combustion of fuel, $270,000,000 for tubercular and other diseases induced, and $140,000,000 for damage to merchandise, extra cost of cleaning, etc.

The engineers on the staff of the Smoke Investigation, basing their figures on every type of stoker and hand fired furnace, estimate the loss up stack at 25 per cent. and other losses 20 per cent. On this basis they find that 4.6 lbs. of coal per boiler H.P. per hour are used, while under conditions which could be reached, only 3.6 lbs. would be required, which means a saving of 21.7 per cent. of the fuel consumption. Placing the coal consumption of the Pittsburgh district at 16,000,000 tons worth $20,000,000, the loss due to imperfect combustion which could be overcome would be $4,340,000 per annum. The total loss, part of which is unavoidable, would be 45 per cent. of the calorific value of the fuel, equal to $9,000,000 per annum.

"The chemical action of daylight in Pittsburgh is about 60 per cent. of what it is in Sewickly a small residential town." "There is evidence that in general the chemical intensity of sunlight in large cities is 25 per cent. less than it is in small towns."

The soot fall per sq. mile per year has amounted to 220 tons in Leeds, Eng., 820 tons in Glasgow, and 259 tons in London.

In Pittsburgh a recent investigation by Dr. W. C. White shews that pneumonia increased with the density of atmospheric smoke, irrespective of the density of population or of poverty.

AMERICAN PEAT SOCIETY.

The 8th annual meeting of the American Peat Society is to be held at the rooms of the Commercial Club, Duluth, Minnesota, on August 20, 21 and 22, 1914. This meeting promises to be a most important one in the history of the Society, as well as in the movement already begun by State and National Governments to reclaim the swamp lands of the country. The interest in this meeting is shown by the number and variety of papers already promised. It is expected, from enquiries from Europe, that representatives of the Governments of some of the more important peat using countries abroad will be present at the meeting and take part in the proceedings. Timely papers from European investigators and practical peat producers are already promised. Amongst the papers on the preliminary programme are the following:—"Problems to be Solved in Developing a Dewaterer for Peat," by G. Herbert Condict; "Latest Development in the Peat Gas Producer," by B. F. Haanel, of the Canadian Department of Mines; "The Possibilities of Peat in the Beneficiation and Smelting of Iron Ores," by Prof. Peter Christiansen, of the University of Minnesota; "Converting Peat into Fuel," by Prof. Charles A. Davis, of the U. S. Bureau of Mines; "The Peat Industry in Ireland," by Thomas Tomlinson; "The Use of Peat in the North-West Provinces of Russie," by Engineer Q. v. Lubkowski, of Warsaw; "Peat Briquetting," by Dr. J. McWilliam; "Briquettes from Peat and Petroleum," by Robert Blei, of Sacramento, California; "Practical Demonstration of Herbein's Patent, by a Small Working Model of the Herbein Briquetting Machine," by C. A. Squire, of Cleveland, Ohio; "How to Prepare a Peat Bog for Fuel Making," by Gustave Carlsson, of Farnham, Ont; "Application of Machinery on Peat Deposits," by L. A. Krupp, of Findlay, Ohio; "Economic Aspect of Peat in America," by John N. Hoff, of New York; "Comparative Costs of Drying Peat Fertilizer with Fuel Oil and Coal," by John Wiedmer, of St. Louis, Mo.; "The Peat Industry of Russia," by Gr. Lisitziu, of Riga. An exhibition of peat, peat products, and anything pertaining to peat development has been arranged under the auspices of the Duluth Committee of Arrangements.

THE NEW SULPHATE OF AMMONIA MANUFACTURER'S ASS'N.

At the annual meeting of the Sulphate of Ammonia Committee it was agreed that the committee should be amalgamated, recently formed, under the title of the Sulphate of Ammonia Association, with two sections, the one to carry on propaganda work, which has hitherto been the sole work of the Sulphate of Ammonia Committee, and the other to attend to the sale of sulphate. Already

makers of sulphate, representing over 200,000 tons per annum, have joined the sales section. It is estimated that an annual contribution of 9d. per ton will cover the propaganda work, and 6d. per ton the work of the selling branch of the Association.

During the year 29 new subscribers joined the committee, representing 19,500 tons of sulphate. The total number of subscribers to the Committee is now 446, representing a total of 303,924 tons of sulphate, an increase over last year of 31,033 tons, being 19,500 tons from new subscribers, as above, and nearly 12,000 tons increase in output from old subscribers. The new subscribers include nine coal and iron firms, with an output of 17,500 tons of sulphate.

For carrying on the work of the Selling Committee of the new Association, the country has been divided into five districts: (1) Scotland, which as a district is the largest contributor of production; (2) Newcastle and district; (3) Manchester district and Wales; (4) the Birmingham and Midlands district; and (5) London and the South of England. The committee already represent 210,000 tons of the 430,000 tons of sulphate equivalent now produced in this country. The Propaganda Committee—i.e., the old Sulphate of Ammonia Committee—represent a production of 304,000 tons.—*The Colliery Guardian.*

WET PEAT ZONES FOR ARRESTING COAL DUST EXPLOSIONS.

An interesting use of peat is described in a recent number of the Colliery Guardian, viz., for arresting coal dust explosions in mines.

The method adopted is to establish zones by walls or plates of peat along the side walls, which are wetted instead of the strata. The construction of such peat plates is carried out in a simple way by inserting the ordinary brick-like peat pieces between wire netting. Hereby handy plates are formed, which can easily be hung up and removed along and from the road walls, and of which zones of any length can be built.

Peat has the ability to absorb water to the extent of five to six times its own weight, and to retain the same for a very long period. A square yard of peat plates absorbs about 10 gallons of water. At a height of the roads of 2 yards it is therefore possible, when peat plates of the same height are provided on both side walls, to accumulate 40 gallons of water per lineal yard, or 2,000 gallons of water in a peat zone of 50 yards.

As the wetted peat liberates the water very slowly, frequent watering is not necessary. It quite suffices to sprinkle the peat zones once or twice a week, or, in cases where there are water pipes in existence in the roads, to open the valve of a perforated water pipe provided above and along the zones.

An important factor is the great mechanical effect which the torn-off and telescoped peat plates exercise upon flames of explosions, where the heat of the flame is prevented from being transferred into power. This action is also available against consecutive explosions.

A series of tests carried out last year at Derue in Westphalia gave very satisfactory results, which are described and illustrated by diagrams in the article in the Colliery Guardian.

PEAT IN RUSSIA.

Peat is continually growing in importance as a fuel in Russia; this increased use is accompanied by a rise in price. The Government is also giving more interest to peat cultivation. The principal Governments of Petersburg, Nishni-Novgorod and Moscow are establishing schools for instructing the peasants in methods of preparing their peat lands and of using them to best advantage. The selected peasants who go to these schools and complete the course are sent back as teachers to instruct their neighbors.

An interesting departure from Russian practice is being made at Bogorodsk, near Moscow, Russia, where an electric-lighting company has lately acquired an extensive peat bog with a view to utilizing the peat as fuel for the generation of electrical energy on a large scale. It is proposed to establish one of the largest electrical stations in the country near the peat deposits, and to supply the current generated not only to Moscow, but also to the towns and villages within a wide radius from the plant.

In some parts of Russia where fuel is scarce and high in price, so that the glass industry has suffered to some extent, it has been found that some of the works, because of their fortunate location, were able to substitute peat for petroleum and coal, the fuels which they had formerly used. It is well known that the fuel cost is a very important item in the production of glass and those factories that were able to obtain peat at nominal prices have been able to make

much larger profits since the closing down of their unfortunate competitors. It is believed that as a result of the success of these glass works, in the future, new factories will be located only in districts where there is an abundant fuel supply, as well as cheap labor.

The Russo-British Chamber of Commerce has published an account of the work of the Russian Ministry of Agriculture for the last five years (1909-1913), during which period the Ministry has expended 511,500,000 roubles ($263,422,-500) on agriculture, land organization, and improved methods of utilizing and protecting the natural wealth of the country.

During the five years the Ministry has taken the initial steps towards reclaiming marsh and desert land. In European Russian over 17,000,000 acres have been surveyed, about 500,000 acres have been drained, and some 2,000 wells sunk.—*Weekly Notes, Department of Trade and Commerce.*

APPARATUS FOR DISTILLATION OF PEAT.

British patent 12427 (1913), Improvements in and relating to the Distillation of Wood, Soft Coal, Lignite, Peat and Shale, and the Utilisation of the Products of the Distillation for Creosoting Timber and other purposes. D. de Nagy, of 183 Tulse-hill, London, S.W.

Consists of an apparatus for carbonising or distilling timber, soft coal, lignite, shale and peat in piles without retorts or ovens, such apparatus having in its basement chambers into which the distillation products are led and employed for creosoting timber placed in such chambers. Near to the periphery of the floor of the apparatus or fould—on its surface—is a small channel which is provided with openings protected by grates. These openings, or holes, are the communications from the surface with the chambers built below the fould. These chambers, six to twelve, are build in radial form, and communicate below the surface with the chimney which is erected in the centre of the fould. The chimney is provided with a valve, which being opened allows the non-condensed gases to pass to the air, or through a pipe line to a gas reservoir. As many chambers as are required are built airtight of iron sheets. The chambers are so built as to slope to a channel in the basement round the fould which collects the condensed by-products, from whence they flow through a pipe to a reservoir. The fould and chambers are built of brick work, cement or iron; the chimney is built of strong iron sheets.—*The Colliery Guardian.*

UNITED STATES PATENTS GRANTED FOR PEAT MACHIINERY.

1912

Peat blocks turning aparatus. T. A. Mighill; No. 1,015,390; Jan. 23; Sp. p. 5079, Gazette, Vol. 174, p. 875.

Implements for obtaining samples from peat bogs, etc. B. Granville; No. 1,027,246; May 31; Sp p. 4782, Gazette, Vol. 178, p. 805.

Peat drying apparatus. A. S. Cairncross; No. 1,036,072; Aug. 20; Gazette, Vol. 181, p. 633.

Drying raw peat. H. Brune and H. Horst; No. 1,033,779; July 20; Gazette, Vol. 180, p. 1146.

Preparing peat fuel. T. Franke; No. 1,031,638; July 2; Gazette, Vol. 180, p. 274.

Peat machine. A. S. Cairncross; No. 1,019,946; Mar. 12; Sp. p. 2011, Gazette, Vol. 196, p. 347.

1913

Peat delivering apparatus. J. Mackaye; No. 1,053,191; Feb. 18; Gaz. vol. 187; p. 536.

Peat expresser. O. J. Sigler and H. J. Jarvis; No. 1,049,614; Jan. 7; Gaz. vol. 186; p. 102.

Peat laying and cutting machine. T. A. Mighill; No. 1,053,197; Feb. 18; Gaz. vol 187; p. 539.

Peat, slime, and like substances, Treating. G. Wolters; No. 1,074,400; Sept. 30; Gaz. vol. 194; p. 1057.

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Canadian Peat Society

Vol. 3. OCTOBER, 1914 No. 3

A REVIEW OF MODERN USES OF PEAT.

(Reprinted from Indian Engineering. vol 54).

The value of peat as a fuel for the production of gas is now well established. This perhaps is the most important use it can be put to at present, but there are some minor ways in which it is employed, perhaps not generally known. For instance, as litter, for which is utilized the poor imperfectly decomposed fibrous varieties of a mossy brown appearance. Its value as a litter lies in its antiseptic properties and its capacity for absorbing the nitrogenous organic matter, thus improving the quality and quantity of stable manure. Used in dairy barns it is found to keep down odors to a large extent, if changed once every two or three weeks. In the form of dust it is of use for scattering on floors of poultry houses, where it helps to destroy parasites, and with the droppings also forms a valuable manure; for the same reason it may be used in all animal cages. It has also been successfully used in combination with waste fish leavings and with night-soil for manufacturing purposes. As a mixer for soils it has many uses. For potted plants a one-inch layer of peat dust preserves moisture in the soil and is a good protection for the roots against cold and freezing.

In Germany they use peat for the treatment of sewage in a large number of towns not provided with a hydraulic system. The vessels from house closets are collected and conveyed on special carts to the sewage works where they are lifted by elevators to the first floor of the building, emptied mechanically and taken to a cleansing room where they are treated with steam and peat dust in a horizontal cylinder provided with a screw. A screw conveyor then carries the material to a shed where it is stored as manure and sold at a rate equivalent to $2.24 per ton. This manure is said to be odorless and of a moist, powdery consistency resembling

rich mould. The complete plant for a town of 60,000 inhabitants cost about $48,000, and is commonly used for towns with a population of over 10,000. Peat dust is also commonly used as a packing for fruit, vegetables, fish or meat to be dispatched long distances; and, being a good non-conductor, is suitable for packing ice, for covering icehouses, for covering steam and water pipes, heating and cooling chambers, patching bins, etc. To start early vegetables in a greenhouse, decayed peat is admirable for mixing with the ordinary pot soils, using one part peat, one part well-rotted stable manure and one part rotted sod loam. Before use after removal from its bed, it should be allowed to lie in piles for three or four months to aerate, then, after mixing with the manure and loam, be allowed to lie for a month or two before potting.

Like coal, peat varies in quality within wide limits and some purposes to which the inferior qualities may be put have been briefly alluded to above. For fuel purposes it will, of course, be necessary to select the better kinds, and even these need to be pulped and formed into bricks before firing. The great drawback in it is the enormous amount of moisture it contains and so long as it is in the fibrous state this moisture is difficult to drive off. Pulping breaks up the fibres, after which if it is made up into bricks it can be dried more rapidly and completely and converted into hard blocks which ultimately contain from 18 to 25 per cent. of moisture only. Bricks of first-class quality may be turned on the lathe and in appearance resemble Irish bog oak. Good Scotch and Irish peats contain only 1 to 1¼ per cent. of ash and, when bricked, the calorific value of 1½ tons is equivalent to the calorific value of one ton of good coal. On this basis and on the fact peat bricks can be turned out at 96c or $1.20 a ton, it can always be worked out if it is possible for it to compete against coal. It has, however, always some inherent advantages over coal which have to be considered in balancing the question of its use. It is cleanly to handle, burns brightly and clearly, produces practically no smoke and is even said to raise steam more rapidly than coal; and for these reasons it is used largely in Holland, where it actually costs more than coal. Moreover, it seems to have been proved that it burns to better advantage when employed with coal, either coal briquets or ordinary coal, in the ratio of 1 to 1. If a good class of peat be made carefully into bricks and then be subjected to dry distillation, a very good dense charcoal is produced, most useful for metallurgical processes, as it can carry a good load without crushing. In the process of distillation valuable by-products are also obtained, the following being given as recoveries from 100 tons:—Sulphate of ammonia, 1½ tons; acetate of lime, 5 cwts.; methyl alcohol, 60 gallons; crude oils, 2 tons; creosote oils, 1½ tons. The coke (charcoal) varies from 30 to 34 tons and enough gas is given off, after once the retort has become thoroughly heated, to fire the retorts and carry on the process of distillation, with a large surplus of high calorific value to use for gas engines or to fire boilers. The great secret of financial success in a great venture is ability to drain the peat bog without undue expense. If a large percentage of

the moisture, often amounting to 90 per cent., can be driven away, then the peat can be economically cut and stacked to dry till the moisture drops to something below 30 per cent. It needs, of course, the summer months for drying, at the same time it must not be imagined that if left exposed through a wet winter the summer's work is undone, because dried peat will re-absorb only a small proportion of rain. It is used as a domestic fuel in both Scotland and Ireland without any draining of the bogs, but is merely cut from the bogs and sun-dried. As a means of producing gas to be employed for power purposes its success is quite established in cases where the conversion can go on at the site of the bog, that is when the peat has not to bear the cost of carriage and the power generated can be utilized in the neighborhood. The gas is as good as that from the best Welsh anthracite and the by-products also just as good. Cheap drainage of the bog is the basis of success and wherever this is effected so that peat with the reduced percentage of moisture required can be put into the gas producer at anything under 96c a ton, success is assured. As a domestic fuel it is said to be preferred to coal. It kindles more easily than wood and is often used together with billets of beech and oak, because used thus it gives a more lasting heat than wood or coal.

(Note—The tons in this article are gross or long tons).

SASKATCHEWAN LIGNITE.

The following is a brief summary of a talk given October 1 before the Regina Board of Trade by S. M. Darling, who is in charge of the government's lignite experimental station at Estavan. It foreshadows, in a measure, the full report of Mr. Darling's work, which is now being prepared.

The brown coal deposits in southern Saskatchewan are the sole sources of fuel in the vast territory between the head of the great lakes and the Rocky Mountains. In character they are true lignite of cretaceous age. The woody structure is very marked. As to quantity, there are not millions but billions of tons east and west of the Souris river, and he would be a pessimist indeed who would not feel sanguine of the future of a country possessing such enormous sources of fuel and power.

The reason why this lignite is not more generally used is to be found in some of its physical characteristics. But the obstacles should not discourage us. When anthracite was first discovered it was regarded as useless until someone stumbled on a way to burn it, and then there arose a splendid industry. The same is true of lignite. And the size of the anthracite trade will not at all compare with this lignite industry when the lignite comes into its own.

First it must be dried. This will eliminate the freight on the 30 per cent. content of water, and the necessity of evaporating that water in the furnace. For

this purpose it must be crushed to about one inch. The larger sized lumps of the dried fuel can be burnt on automatic stokers similar to those recently installed in the power plant of the city of Regina. The smaller sized lumps will be passed on to the briquette section or to the carbonising oven, to be carbonised before being briquetted. There is no waste whatever and no lost motion in handling.

At Superior, Wisconsin, I recently dried a carload of lignite, briquetted it and burned the briquettes in a boiler test under the boilers at the Parliament Buildings, Regina. Mr. Smyth, the chief engineer, supervised the test and kept the records. The amount of water evaporated per pound of fuel as fired was 6.36 pounds. Temperature of feed water 57 degrees Fahrenheit. Last January in a test at the city power plant, using a good Alberta coal, under like conditions, the amount of evaporation was 6.5 pounds per pound of fuel as fired. With equipment designed specially to handle this lignite we can make briquettes that will be fully equal to the western coals in evaporating efficiency. In this test I was under the handicap of not being able to dry the lignite thoroughly. The lignite dust is very explosive. The drying plant was not equipped with explosive safeguards, and, not wishing to risk blowing up the plant, the moisture was reduced only from 30 per cent. to 10 per cent. A plant equipped for the purpose would remove practically all of the moisture. That 10 per cent. of moisture was, of course, a great handicap and yet the results with the briquettes were practically the same as with the western coal. These briquettes were not made one at a time in an experimental way, but came through the press at the rate of 35 tons an hour.

No byproducts are, of course, obtained where the lignite was simply dried.

I believe, however, that the most profitable way to utilise the lignite is to carbonise it; that is, to distil off all volatile matter.

On carbonisation, the products, in round numbers are:

1. Gas, per ton of lignite ..... 10,000 cubic feet
2. Oil or tar per ton ..... 15 gallons
3. Ammoniacal liquor ..... 35 gallons
4. Carbon residue ..... 1,200 pounds

The gas has a heating value of 400 British thermal units per cubic foot and makes a good "town gas," for use in stoves and ranges. It is not a good illuminating gas; it is serviceable principally for fuel and power.

There is more gas in one ton of lignite than is required to carbonise the next ton. This surplus gas has a very direct bearing upon the matter of cheap power. Six thousand cubic feet of gas are required to carry on the carbonising, leaving a surplus, costing nothing, of 4,000 cubic feet per ton to be used for power.

The market for domestic fuel is very large and it is not unreasonable to expect that the demand for carbonised lignite for gas producers, and domestic fuel in the shape of briquettes, will be sufficiently large to yield from the surplus gas all the power required within a wide range of the lignite fields. The power derived from this surplus gas costs less than Niagara water power, $8 per horse

power year. If necessary the amount can be augmented by using carbonised lignite in gas producers.

The oils and tars extracted from the lignite can be put to many uses—fuel oil, creosoting oil, leather preservative, water proofing, tar paper, roofing pitch, etc. The pitch makes an excellent binder for briquettes and will go far towards reducing the cost of this item. Almost all our coal tar dyes and other coal tar products have heretofore come from Europe, principally Germany. Several million gallons of creosoting oils for preserving timber have been imported annually. That supply is now cut off and the value of these materials on this continent greatly enhanced. It is unfortunate that we are not now ready to supply a large part of this demand from our immense stores of lignite.

From the ammonia compounds is derived a substantial quantity of valuable fertiliser.

Lump carbonised lignite is the ideal gas producer fuel. The amount of gas is equal to that from anthracite pound for pound, but the gas is richer, far less tar and less clinker and burns more freely.

The 100 horse power producer gas plant in the Leader Building, Regina, has used six carloads of this carbonised lignite, and on anything approaching a full load they got a horse power on each pound of fuel. There are two dozen gas producer plants in this territory that will use this carbonised lignite when it can be supplied in sufficient quantities. It means a reduction of 30 per cent. in their fuel bills.

As a domestic fuel the carbonised lignite briquettes are fully equal to anthracite, ton for ton. They have a heating value of 12,000 British thermal units per ton as against anthracite's 13,000 British thermal units. But there is no clinker from the lignite briquettes, no loss in burning, and they can be used nicely in kitchen ranges, which is impracticable with hard coal.

These different samples of carbonised lignite briquettes which I have here were not made in a laboratory, but on commercial presses, used to briquette bituminous coal, at the rate of 10 to 35 tons per hour. These were all made from Souris lignite. They can be marketed in this territory at a price very much lower than that of any other domestic fuel of equal value.

This drying, carbonising and briquetting of the lignite results in substantial economies from the standpoint of the mine owner. There is not the large waste in screenings as at present; every pound mined is used for some purpose. The product is put into such a condition that it can be stored indefinitely and shipped any distance without deterioration. This is not possible with the raw lignite, which can be mined only as it is used. The lignite mines are therefore idle a large part of the year. This ability to operate at a steady rate throughout the year, storing the products during the summer for shipment in winter, will effect a decided reduction in the cost of production.

To sum up—

1. For *domestic fuel* for heating and cooking there are dried or carbonised lignite briquettes.

2. For *steam raising* purposes there are dried lignite for automatic stokers, dried lignite briquettes for hand fired furnaces, and powdered fuel.

3. For *electrical power* there is the carbonised lignite for use in gas producers at local points in different parts of the country; and, when the time comes, if it is not already here, the surplus gas from the carbonising process will be adequate to generate current at Niagara rates for distribution over a wide area from a central station at the mine.

4. Finally there is the utilisation of the byproducts, which is bound in time to be a large industry in itself.

LEGISLATION FOR THE PROTECTION OF MOORS IN GERMANY.

Landwirtschaftliches Wochenblatt fur Schleswig-Holstein, amtliches Organ des Landwirtschaftskammer, Year 64, No. 18, pp. 405-6. Kiel, May 1, 1914.

The law of March 4, 1913, for the protection of moors in the province of Hanover has been extended (April 1, 1914) to the provinces of Pomerania and Schleswig-Holstein.

The object of the law is to prevent the uneconomical exploitation of moors. It prescribes that plots of land which alone or with others form a compact area of moor more than 25 ha. (62 acres) in extent, so far as public interest requires it, can only be worked for peat in such a way as to ensure their further profitable use for agriculture or forestry.

The use of such plots for cutting out peat requires the authorization of the district committee, for which an application has to be made. Before granting the authorization a competent office to be nominated by the Minister of Agriculture, Domains and Forests has to be consulted, as well as the Improvements officials. If requested, an expert named by the applicant has also to be heard. Against the decision of the district committee the applicant may appeal within two weeks to the Minister of Agriculture. Undertakings which had already begun cutting out peat before the law had come into force may continue to work for six months longer without being subject to the limitations of the new law.

The authorization to cut out peat is not required when the peat is used in the household or farm of the owner, farmer, or person entitled to excavate peat or of an agricultural laborer under permanent engagement to the owner of the peat bed, when his agreement authorizes him to cut peat for his own household or

farm. Further, the authorization is not required when the peat is cut for sale, provided such cutting be conducted by not more than six persons and without machinery. The district police, however, may issue regulations with regard to peat cutting in order to safeguard the interests of agriculture or forestry.

FUEL-BRIQUETTING INVESTIGATIONS.

Results of an exhaustive series of experiments in the manufacture of fuel briquettes carried on in the United States from July, 1904, to July, 1912, are published in Bulletin No. 58 of the U.S.A. Bureau of Mines.

From 1904 to 1907 the work was carried on at St. Louis, and the Johnson, American Compressed Fuel Company, and Renfrow machines were used. From 1907 to 1910 at Norfolk, the Johnson and Renfrow (improved) plants were employed, together with a German Schlickheysen peat machine. At Pittsburg, from 1910 onwards, the experiments were confined to a German lignite plant made by the Maschinenfabrik Buckau Actien-Gesellschaft of Magdeburg, and a small hand-press.

To determine their evaporative and burning qualities the briquettes were burned under a stationary boiler. Special tests were also made on locomotives, on a torpedo boat, and in domestic furnaces and a foundry cupola. The locomotive tests showed that the evaporative efficiency of briquettes as compared with raw fuel is greater; that firing is easier; and that both the clinker and smoke produced are less. The domestic furnace tests proved that, for the low temperatures common in house-heating boilers, pitch is an unsuitable binder, as it volatilized and escaped, unburned, or became deposited as tar. It also gave rise to too much smoke.

In the experiments the question of what binder can be used to best advantage has naturally been investigated in great detail. Coal-tar pitch binders now employed give briquettes which are waterproof, do not crumble during transport, leave little ash, and can be made at reasonable cost. Other binders, notably cereals and sulphite pitch are smokeless in burning but are not waterproof, so that the briquettes crumble on exposure to the weather. Such briquettes can be rendered waterproof, but the cost has hitherto been considered prohibitive. An American inventor uses 2 per cent. of cereal and ½ per cent. of tar, against, in the ordinary process, 8 per cent. of pitch, and claims the cost of manufacture is cheaper than when pitch is used, so long as the price of pitch is above 42s. 6d. per ton.

Pitch obtained from the distillation of petroleum gas-tar gave the best results, although other pitches distilled from by-product coke-oven tar, illumin-

ating-gas tar, and producer-gas tar proved satisfactory. Clay, lime, cement, magnesium oxide, plaster-of-paris, acid sludge, sugar-factory residues, slaughter-house refuse and wood products proved unsatisfactory, although some of the last-named gave good results in combination with other binders and deserve further investigation. Crude petroleum is deemed unsuitable for working on a commercial scale. Resin combined with pitch or petroleum and a percentage of lime to prevent smoking, makes a good binder, but the cost makes commercial application impossible. Asphalts are too expensive in most places, and give only fair briquettes, but asphaltic tar was found useful as a waterproofing material in briquettes made with starch.

In fact, the only really good binders besides pitch were found to be starch or flour and sulphite pitch, which do not, however, when used alone, give waterproof briquettes. Briquettes made with 2 to 4 per cent. of corn starch were found to be smokeless. They held their shape well in the fire until consumed, and though the heat value of the binder is small, it leaves no ash.

Sulphite pitch, also known as cell pitch, is made from the waste liquors which are produced in the sulphite process of manufacturing paper pulp from wood. Until recently these liquors had no commercial value, and their proper disposal was a serious matter, since, if discharged into rivers, they polluted the water and killed such fish as were contained in it. In making the pitch, the liquor is concentrated to a syrup in a sextuple-effect evaporator, and solidified into pitch as a thin film on two rotating steam-heated drums. With some coals, less than half the quantity of cell pitch is required as compared with ordinary pitch; but with others, in the American experiments, the percentage necessary was the same for each material. German experiments, on the other hand, incline to the smaller value. Briquettes made with this binder are smokeless and odorless, and the price of the material, if there are cellulose mills at hand, is low. In the Pollacsek process, used by the Hungarian government for its collieries, sulphite liquor is employed, and from 3 to 5 per cent. is found to give good briquettes. The briquettes made with sulphite pitch can be rendered waterproof by drying at a temperature of 300 deg. Cent. or by the addition of certain chemicals, the nature of which is not at present divulged. With the latter process, the cost of waterproofing is estimated at 1s. 6d. per ton of briquettes.

In Germany the cost of making lignite briquettes, including all materials, works out at 7s. 6d. per ton, the lignite being taken at ½d. per bushel.

CONVERTING GERMAN PEAT MOORS INTO GAS AND ELECTRICITY.

During many years the Prussian government has endeavored to secure the utilization of the extensive moors in the neighborhood of Bremen, in the Province

of Hanover, and large sums of money and great efforts have been expended for this purpose. A "Moor Experimental Station" was located at Bremen, where means and ways were studied, and experiments with the soil of the moors were made to discover a method whereby these extensive waste lands might be brought under cultivation, and induced to yield their proper share of production.

The Government had dug, at its own expense, drainage canals in the governmental district of Aurich, East Frisia. The transportation of the great quantities of peat, dug out on this occasion, to the larger peat-consuming cities was too expensive, and it had to be disposed of in some other manner. Thereupon the Government erected a power station in a convenient location on the land to be drained, using the peat as fuel. Thus originated the power plant at the Friedeburger Wiesmoor.

Shortly after establishment this plant was sold to the Siemens Elektrische Betriebe, which enlarged it considerably. It now supplies electricity to the cities of Norden, Emden, Aurich, Bant, Wilhelmshaven, and also to a large rural district.

In establishing the gas and electricity plant in the Schweger Moor, Province of Hanover, ideas and methods were carried out similar to those which proved of practical worth in the founding and development of the Friedeburger Wiesmoor plant.

For the purpose, however, of obtaining certain valuable by-products there was followed at the Schwegermoor plant the advice of the experts, Geheimrat Prof. Dr. A. Frank, Charlottenburg, and Dr. N. Caro, Berlin.

The peat is gasified, leaving sulphate of ammonia, a valuable fertilizer, and tar as by-products in sufficient quantities to meet the running expenses of the plant. The gas is used as fuel in generating electricity, while the tar serves as fuel under the gas generators.

This indirect way of making use of peat as fuel has one great advantage which must not be underestimated. It is generally known that in order to advantageously use peat as fuel the peat must not contain more than 30 per cent. humidity. In this climate of nearly constant dampness it is very difficult to obtain dry peat in such quantities as would be needed for fuel by such a large plant. As peat, for gasification, may contain up to 70 per cent. humidity,† it is much easier to supply the plant with the necessary quantity, the more so as under such circumstances peat gathering may be extended until late in the fall.

To run the new plant Hannoverche Kolonisations und Moorverwertungs Gesellschaft, a limited stock company was formed, with headquarters at Osnabrueck. This company purchased the Schweger Moor which covers about 2,471

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†(Though claims have been made of gasification of peat containing as high as 70 per cent. water, it is open to serious question whether this is economically practicable.—Ed.)

acres, and is in the Kreise (district of) Wittlage and Bersenbrueck, near the city of Osnabrueck. In the spring of 1910 construction of the plant was begun, and on October 2, 1911, the first electricity was supplied.

The peat which is to be gasified is broken up by a tearing machine and then passes from the bunker into the generator. The gas obtained undergoes a purifying process and is said to be ultimately absolutely pure. The salt obtained by this method is said to be also of good quality. The following will illustrate a good average of the working process at this plant:

During December, 1911, there were gasified 1325 metric tons (1,000 kilos equals 1 metric ton, equals 2204.6 lbs.) of raw peat, of 60 per cent. humidity, being equal to 530 tons of absolutely dry peat. The fuel used in this particular process consisted of 170 tons of raw peat, of the same humidity, equal to 68 tons of dry peat, together with some tar. It may be observed that the use of peat as a fuel has since been discontinued, tar alone being now used in operating the plant.

The above-mentioned 530 tons of dry peat produced as a by-product 18.3 tons of salt, or 34.5 kilos, per metric ton of dry peat, containing about 1 per cent. of nitrogen. This means that about 75 per cent. of the nitrogen contained in the peat has been made useful in the form of sulphate of ammonia—a very favorable result.

The above-mentioned 530 and 68 tons, equalling 598 tons of dry peat, produced 427,000 kilowatt (hours) power, or 715 kilowatt hours, per metric ton of dry peat, being about the same as 1000 electric horsepower ,for one hour) to the ton of dry peat.

UTILIZATION OF PEAT IN ITALY.

From a lecture delivered by Prof. Ugo Rossi at a meeting of the Association of Italian Agriculturists in April last the following information is gleaned:—

Several of the more important peat beds in Italy have been worked, chiefly with a view of utilizing the peat as fuel. Most of the peat is however too poor to compete with imported coal, hence the lack of success in such undertakings, even where they were connected with land reclamation schemes. Attempts have also been made to use peat for other purposes, such as litter, packing and isolating material, etc., but the quantities thus used were too insignificant to be of economic importance. Of late, however, the nitrogen contained in peat has attracted considerable attention; this nitrogen is practically in an inert condition in the raw material, and in order to utilize peat successfully as a manure, the nitrogen must be transformed into a more active compound, such as a salt of ammonia.

The idea of subjecting peat to the water-gas process was suggested by Dr. L. Mond, and the first plant erected for the purpose was that at Orentano in the

Province of Lucca, Italy, which has since been much improved by the addition of plant for preparing and drying the peat. The latest works to be erected are those at Codigoro, Italy, where all difficulties are said to have been successfully overcome.

The process adopted for treating peat is as follows:—The peat, properly dried and broken up, is thrown into a turret-shaped oven 26 to 33 feet high, called the gas oven, which is fed at intervals from the top. The peat burns only in the lower part of the turret, the combustion being regulated by a jet of hot air and steam. The water vapour decomposes on the incandescent mass, producing, together with the other combustion gases, the so-called water gas, or in this case Mond gas, which collects in the top of the oven. It is produced at the lowest possible temperature, and the nitrogen evolved from the peat combines with the nascent hydrogen and forms ammonia. The gas thus produced is then washed to free it from the tarry products it contains, and is led into a leaden chamber where it is met by a spray of sulphuric acid which converts the ammonia into sulphate, while the remaining gas is purified, cooled and burned under the steam boilers, in the drying ovens or in gas motors. In this way about three-quarters of the quantity of nitrogen contained in the peat is converted into sulphate of ammonia. A peat containing 2.5 per cent. of nitrogen yields about 175 lbs. of sulphate of ammonia to the ton.

At Orentano about 1800 cub. ft. of peat can, at present, be treated daily, yielding 50 tons of sulphate of ammonia per month, and before long the output will be doubled. The gas is used in the works, and at a central station, developing about 800 H.P.

The results obtained at Orentano encouraged the company to erect large works at Codigoro (Ferrara, Italy) in 1912. These are now capable of dealing with 150 tons of dried peat daily and of turning out from 10 to 12 tons of sulphate of ammonia per day. The peat beds at Codigoro are upwards of 2500 acres in extent. The company has already spent £240,000 on the two factories, but it can now produce sulphate of ammonia at 4s. 10d. to 5s. 7d. per cwt., while the market price is above 12s. per cwt.

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CANADA'S PEAT BOGS A VALUABLE ASSET.

Attention is being drawn to the possibility of expansion of Canadian commerce and industry as a result of the war. This may take the form of domestic production of articles for a supply of which we have been dependent upon foreign sources, or of increased exports to other countries of products hitherto supplied by Germany and Austria.

Among other things this emphasizes the importance which development of the latent resources of Canadian peat bogs might readily assume if full advantage of the new conditions arising from the war were taken.

Sulphate of Ammonia, the chief by-product of European peat plants, is a valuable fertilizer worth about $60.00 per ton. The world's production last year is estimated at 1,365,000 tons, worth about $80,000,000. The chief importing countries are as follows, the figures representing excess of consumption over production:—

	Tons	Value
United States and Canada	58,000	$3,500,000
Japan	115,000	7,000,000
Java	57,000	3,500,000
France	15,000	900,000
Spain and Portugal	42,000	2,500,000
Italy	15,000	900,000
	302,000	$18,300,000

Of these amounts the portion supplied by Germany and Austria was:—

	Tons	Value
Germany	90,000	$5,400,000
Austria	30,000	1,800,000
	120,000	$7,200,000

These figures shew the existence of extensive markets which might be supplied, in part at least, by Canada, and of an opportunity to capture some share of the trade of Germany and Austria in this product.

The extent and rapid growth of the domestic market for artificial fertilizers is shewn by the following statement of Canadian imports for 1902 and 1903 and the past six years.

Year	Value
1902	$ 84,996
1903	112,256
1908	403,171
1909	529,660
1910	548,493
1911	586,453
1912	620,147
1913	737,656

Many Canadian peat bogs are rich in nitrogen, and therefore suitable for this industry, and enquiries have already been made by British capitalists with a view to establishing chemical works in Canada, provided that a sufficient supply of peat can be guaranteed.

Apart from the potential value of our peat bogs as a subsidiary source of fuel supply and for production of sulphate of ammonia, there are numerous other products such as moss litter, peat dust, alcohol, acetic acid, acetone, tar, tar oils, creosote, etc., which might form the basis of paying industries giving employment to many people, where now we have only waste lands.

In the peat bogs of Northern Holland alone it is stated that about $3,000,000 worth of peat fuel is made yearly, and over 200,000 tons of peat moss litter. About 10,000 families are employed in the peat fields, and many prosperous towns owe their existence and prosperity to the industry. In addition to shipments made by rail, it is estimated that peat furnishes annually about 48,000 cargoes to the Dutch canal boats.

PRODUCER GAS PLANTS IN THE UNITED STATES.

The total horse-power of gas-producer plants in the United States in 1911 was 160,000, of which 80,000 was obtained from bituminous coal, 70,000 from lignite anthracite, and 10,000 from lignite. The cost of producer-gas installations is about equal to that of reciprocating steam engines; the cost of maintenance is only about one-half, while the economy has been shown in several cases to be two or three times as great. The heat losses in typical steam and gas plants are given in the following table:

	Steam plant	Gas plant
Heat lost in ashes	2.00	1.10
" lost in ashes, radiation and cooling	4.60	18.60
" lost in smoke	24.60	----
" lost in smoke radiation and friction	3.30	4.30
" lost in exhaust	53.50	23.70
" lost in exhaust jacket water	----	33.50
" lost in exhaust auxiliaries	7.30	----
Total losses of entire plant	95.30	81.20
Net efficiency of plant	4.70	18.80

—*Canadian Engineer.*

PATENTS RELATING TO PEAT ISSUED BY THE CANADIAN PATENT OFFICE.

No. 155425—May 5, 1914.

Edmund Arthur Buckle, Beech Villa, Guest Road, Prestwich, Manchester, England, Chemist and Engineer.

This invention relates to the treatment of peat and the like whereby it is freed from its natural water. It is known that when peat in an admixture with water is heated to a temperature of 180°C. to 200°C. under a pressure of 20 to 25 atmospheres, the natural water of the peat is rendered expressible without any substantial decomposition of the peat taking place. It has also been proposed with a like object to subject peat to electro-osmosis in one instance under slight pressure and in another case at a temperature above the normal. The present invention is based upon investigations carried out with a view to ascertaining the most favorable conditions for the treatment of peat with a view to rendering its natural water expressible without any material decomposition of the peat. Such investigations have demonstrated that at temperatures below 85°C. peat is so bad a conductor that no electro-osmotic process can be advantageously applied. At 85°C., however, the peat is conductive and if a current is passed for a sufficiently prolonged period, the desired change in the peat ensues with more or less completeness. According to the present invention an electric current is passed through peat heated to a temperature of at least 100° C. under a pressure sufficient to prevent the formation of steam. The electric current may be continuous or alternating but a continuous current is preferred as with it in general a lower temperature suffices than is required with an alternating current to produce as good results. The voltage may vary within wide limits, but a voltage of about 200 has been found to be on the whole the most economical. As stated above the temperature used is at least 100° C., and the range of 100° to 120° C. with a pressure of about 10 atmospheres is preferred but much higher temperatures with correspondingly increased pressure may be used. If the temperature exceeds 150°C. which is the lowest at which it is believed the hydrocellulose of peat is decomposed by heating peat with water under pressure without the passage of electric current, the electric current so accelerates the decomposition as to make the process economically advantageous as compared with the case where other conditions being the same no current is employed. This invention may be carried out in the following manner:—

Peat pulp from a disintegrator is forced by a pump at a pressure of 10 atmospheres into a feed tank in which are paddles mounted on a shaft having at its end a screw. From the tank the peat pulp is forced through tubes preferably of elliptical cross section which tubes pass through a chimney and then through a liquid conducting medium contained in a boiler and heated to a temperature of preferably about 120°. The peat pulp is forced under pressure of 10 at-

mospheres through the tubes at such a rate that the temperature of the peat pulp at the outlet of the heating chamber is at least 100°C. If the tubes are circular, their diameters would usually be from 1 to 3 ins. and the boiler may be 20 ft. long.

The peat pulp then passes to an electrolysing chamber in which is an electrode consisting of a metallic rod insulated electrically from the rest of the apparatus and provided with baffle plates so arranged that the peat pulp is forced in close contact with the electrodes.

As the heated peat pulp traverses the chamber a continuous electric current of 200 volts is passed through it, the peat pulp being thrown into a state of osmotic action, producing a rapid and complete disintegration of the cellulose structure of the peat, and thus allowing the decomposition of the hydro cellulose to take place. If the passage of the peat pulp between the electrodes be arrested, the electric current automatically ceases to flow as the peat ceases to conduct electricity immediately the hydro-cellulose in it is decomposed.

From the electrolysing chambers the peat pulp enters tubes extending through the feed tank giving up its heat to the pulp in it. The cool peat from the tubes then enters into a main leading to filter presses in which the water is removed by the action of a very slight pressure.

Means should be provided to change the direction of flow of the electric current, that is to change the polarity of the electrode and so prevent any accumulation of peat material on the positive electrode.

The peat may be used in the form of producer or other gas, sulphate of ammonia being obtained as a by-product.

A proportion of lime, either as hydrate or carbonate may be added to the peat pulp before it is heated by this process to assist in the decomposition of the hydro-cellulose and to prevent any corrosion of the apparatus by combining with any acid produced by the re-action.

It may be pointed out that the passage of the electric current does not heat the peat to any appreciable extent and that the disintegration of the cellulose structure of the peat allowing the decomposition of the hydro-cellulose in the process, the subject of the invention, is not due to heat generated by the electric current acting as an electrical heater.

Claims:—

1. In a process for the extration of water from peat and like substances passing an electric current through a pulp of the same heated to a temperature of at least 100° C. under a pressure such that no steam is produced substantially as described.

2. In a process for the extraction of water from peat and like substances, passing an electric current through a pulp of the same heated to a temperature of 100 to 120° C. under a pressure of about 10 atmospheres substantially as described.

155554—May 12, 1914.

James Sidney Whitaker, Engineer, 61 Loreburn St., Dumfries, Scotland. (assigned to Wetcarbonizing Limited).

Apparatus for Removing Roots and the Like from Peat.

The apparatus into which the excavated peat is fed is provided with an element which feeds the peat through the apparatus, and with another element against which the roots or other larg objects come into contact in passing through the apparatus. When this occurs, one of the elements acts as an abutment, against which the roots or other large objects come into contact in passing through the object until separated from the peat mass, and ejected from the apparatus.

155658—May 12, 1914.

Constantin Zelenay, Moscow, Russia. (Roschdestwensky Boul 10, log. 20).

Peat Working Machine.

An improved combination machine for cutting peat from a drained peat bog and treating the cut peat. Consists substantially of a tubular cutting apparatus provided at its lower end with an apparatus for loosening and cutting up the peat which is lifted by a worm conveyor and conveyed to a mixing apparatus.

No. 156,544—June 30, 1914.—N. Testrup, T. Rigby and O. Soderlund—assigned to Wet-Carbonizing Limited.

Utilization of Peat.

After wet-carbonization of peat it has been found that to reduce it even to the highest water content at which gasification can be conveniently carried on, say to 50 per cent., the dewatering must be effected in two stages, viz: first, the production, as in a filter press, of a more or less solid cake from the material, and, second, the pressing of the cake as in a band or other mechanical press, or alternatively, its drying by suspending it in a finely divided state in hot products of combustion resulting from heat or power generation in the process.

Under the method described the peat, cut from the bog by an excavator mounted on a pontoon, is disintegrated and pumped through a pipe line to the factory reservoir. Thence it is pumped to a wet-carbonizer, and after having been treated by heat passes to a store vessel feeding a bank of filter presses. The filter press cakes are conveyed to a band press where a further quantity of water is removed. At this stage the product is divided into two parts, one of which goes direct to a gas producer furnishing heat for the wet-carbonizer, while the other portion is pulverized and passed through a rotary drier heated by the waste products of combustion. The gases generated in the drier may be carried by a

conduit to the air inlet of the gas producer to supply a large proportion of the steam necessary therefor. After being dried the material is carried to a briquetting press, and there becomes a finished fuel. The gas in the producer is treated to recover the ammonia as ammonium sulphate.

Apparatus for carrying out the process is shown, and several modifications are described.

Claim 1.—A process for obtaining ammonia compounds from peat consisting in first subjecting the peat in the form of a pulp to heat treatment, such as wet-carbonization, then treating the peat in two stages to reduce the water content, in the first stage the peat being treated in a filter press as a liquid, and in the second being treated in separate apparatus as a solid; and finally gasifying the dried peat.

Four other claims set forth modifications.

No. 158,165—October 6, 1914.—Nils Testrup, London, England. Assigned to Wet-carbonizing Limited.

Wet-carbonization of Peat.

The commercial success of the Ekenberg process will depend upon the quantity of heat that must be supplied to render the water expressible from peat without causing any substantial decomposition of the peat or distillation of the hydro-carbons. It has been observed that when, in carrying out this process, the peat reaches a temperature above 180° an exothermic reaction takes place within the peat and results in the liberation of a large quantity of heat. The apparatus is adapted to regenerate this evolved heat.

Claim—A modification of the Ekenberg process in which pulped peat is passed consecutively through double concentric tubes and heated under pressure while passing through said tubes, characterized by heating the tubes at one end for at most one-third of their entire length to a temperature of approximately not less than 180°, thereby starting an exothermic reaction which causes an automatic rise in temperature sufficient to complete wet-carbonization and to regeneratively heat the incoming peat without requiring the heating from without of the entire length of the tubes.

No. 158,166—October 6, 1914—Thomas Rigby, Dumfries, Scotland. Assigned to Wet-carbonizing Limited.

Method and Apparatus for Removing Water from Peat.

It has been ascertained that peat which has been wet-carbonized according to the Ekenberg process gives up water more easily and to a greater extent when pressed hot than when pressed cold.

According to the invention methods of heat treatment employed are modified so as to take advantage of this property. This is effected by regenerating the heat of the hot treated peat in the usual manner, but in addition by interrupting the cooling before the temperature has fallen sufficiently low to affect appreciably the ease of pressing, whereupon the peat is pressed and the heat regeneration then continued by using the hot effluent instead of the peat to impart heat to the cool raw material awaiting treatment. The best temperature for pressing appears to vary considerably, but usually a temperature below 70° Cent. is to be avoided, while, on the other hand, a limit is placed on the use of high temperatures by the inconveniently high temperature then occurring in the neighborhood of the filter or other presses.

Claim 2—A method of de-watering peat by wet-carbonization consisting in heating peat until wet-carbonized, cooling the material to about 70° by means of raw peat awaiting treatment, pressing the wet-carbonized peat at about this temperature and cooling the expressed liquid as far as possible by means of a further quantity of raw peat while out of contact with said liquid.

Three claims.

BRITISH AND FOREIGN PATENTS.

British Patent 18920, 1913.—Improvements in and Relating to the Treatment of Lignite. T. Rigby, Dumfries, Scotland, and N. Testrup, Westminster.

Relates to the drying of lignite and especially in connection with such processes as are described in Patents Nos. 14642 of 1911, 24748 of 1911, and 969 of 1912. In drying such material by suspending it in a current of hot gases, it has been observed that variability in the temperature of the gases, of the water content, of the raw material, etc., are so liable to upset the balance in any predetermined set of drying conditions, and to result on the one hand, in irregularly dried material, or, on the other hand, in unnecessary loss of heat, and generally speaking, inefficiency, that despite the various proposals for attaining a predetermined result by choice of appropriate length of the drying duct and use of heat storage elements, or to control the drying by regulation of gas speed or temperature (including addition of hot gases from an auxiliary source or addition of cooled exit gases) and of the feed of moist material, such variability still markedly influences the results. It has been ascertained that the harmful variations above referred to are most markedly reflected in variation of temperature of the gases at the end of the drying operation, and that if the latter temperature be maintained between the limits of 75 degs. Cent. and 150 degs. Cent. imperfect and uneconomical working is avoided. The invention consists in the first place in maintaining the temperature of the outflowing gases between these

limits, and the control is most conveniently effected by varying the rate of introduction of the moist material into the gas current, or by by-passing some of the gas, or adding to the gas stream cooled gases which have already done their work. Again, it has been observed that owing to various local circumstances, such as occasional deposit of small quantities of the powder on the bottom of the drying duct, and consequent over-heating, small quantities of the material may become ignited; and in order to avoid all likelihood of such ignition having any serious consequences, the drying duct and its auxiliaries are, according to this invention, constructed of such strength as easily to withstand the full explosion pressure which this material is likely to attain (5 to 6 atmospheres at most), so that in the event of explosion, the pressure would be dissipated through the outlet or outlets of the duct, and no ill-effects be felt within the factory.

British Patent 18932, 1913.—Improvements in the Treatment of Peat for Industrial Purposes.—A. Dickson and A. Smythe, Dublin.

Relates to improvements in the treatment of peat or bog material for industrial purposes, such, for instance, as the preparation of the material for fuel, or other purposes. According to the invention yeast is added to the peat or bog material to be treated whilst in its liquid state. The material is preferably arranged in tanks, in which it is heated to a temperature of about 90 degs. Fahr., when fermentation takes place, which results in the separation of the solid matter from the liquid. The superfluous water is then drawn off by means of a tap or siphon, and the resultant solid product may then be removed, and be passed through rollers or squeezers, or otherwise treated, to remove or express the moisture according to the purpose for which it is intended. The peat or bog material thus treated provides a valuable artificial manure. Further, the material is more easily freed from water after fermentation, which latter increases its value for fuel or distillation.

British Patent 18984, 1913.—Improvements relating to the treatment of Peat, Sawdust, Nutshells, and other Ligneous or Carbonaceous Materials.—R. F. Strong of Queen Anne's Chambers, Westminster.

Relates to the treatment of peat, sawdust, nutshells, and other ligneous or carbonaceous materials for the purpose of obtaining therefrom alcohol, acetic acid, acetone, motor spirit, and other products. In carrying out the invention, peat direct from the bog is delivered into a retort having vertical shafts, to which

are affixed arms with cutting edges revolving towards each other, so that as the peat passes slowly towards the bottom, the fibres of the peat are thoroughly masticated, thus opening the cells, the retort being heated by the gases from other retorts in the plant. At the same time hot air is driven in at the bottom of the masticating retort from gas heated stoves of the Cowper or other suitable type. The heated gases from the peat pass out at the top of the masticating retort through a pipe into a condenser in a water tank for the recovery of the by-products and separation of alcohol, nitrates, etc. The half-carbonised peat passes from this first retort into a second retort by a worm or other conveyor, delivering on to a shelf, and falls thence slowly over other shelves to the bottom, a slowly revolving vertical shaft being arranged in the centre fitted with turning rakes, to move the mass over the shelves. The gases evolved in this second retort pass out at the top through a pipe to a second condenser in water for the recovery of the pyroligneous, tarry products and further separation. The tar liquids in the second condenser, separated or not from acetic acid and other products, may pass direct from the second cooling condenser pipe to a cracker, preferably consisting of a coil in a chamber receiving the red hot carbonised peat from the bottom of the second retort, the coil thereby being kept at a red heat and serving to crack the tarry liquid, the vapour from which passes then through a third cooling condenser. The gases are passed through the usual scrubbers to a gasometer for use for heating the retorts, etc., and the liquid is passed to tanks to separate the light and heavy oils, etc., the hot carbonised peat being removed from time to time from a shoot below the coil chamber. When treating materials other than peat the hot carbonised material may fall from the second into a third distillation retort heated like the others, and discharging the spent material into a shoot below.

British Patent 29,648, Dec. 24, 1912, J. J. Eastick.

In the preparation of a food for animals, sphagnum or peat moss is heated in a digester alone or, preferably, with 0.5-5 per cent. of a hydrolizing agent, such as SO_2 at a temperature of 160° under a pressure of 100 lbs. per square inch for a period of about thirty minutes. The product may be used as fodder, or may be ground or pressed into a cake, or may be mixed with sugar, molasses, or any other foodstuff. The soluble organic matter, including the sugars formed during digestion, may be separated and mixed with other foodstuffs, or may be added instead of molasses, to the unseparated product.

British Patent 7,687, April 1st, 1913.—Molassine Co. and J. J. A. de Whalley.

In the manufacture of a food for animals, undecorticated cottonseed cake is ground or crushed, and the fibres are removed by sifting or dry-vanning, or by an air blast or any suitable separator. The meal so obtained may be freed from the husks and used alone, or may be mixed with other foodstuffs, such as a mixture of molasses and peat or sphagnum. The husks may be ground and mixed with other foods. The husks or husks and fibres, or a mixture of both these with sphagnum or peat may be treated in a digester under pressure, and with or without a small quantity of acid, the husks being converted into sugar and digestible fibres, which are used as food.

British Patent 9,352, April 21, 1913.—F. Sahlfeld.

In a process and apparatus for preparing food for animals from peat, the peat is heated in a boiler for about four hours by steam at 121°. The peat rests on a perforated plate, and the liquid formed, which is kept at the required temperature by a steam coil, is continually pumped on to the peat contained in the boiler. The liquid is finally drawn by a pipe, and may be steamed with bran, beer-malt, etc., or may be mixed with the peat fibre remaining in the boiler.

DIGESTIBILITY OF PEAT.

An article by S. Goy in the Landw. Jahrb. (Vol. 46, pp. 403-408) is devoted to an answer to criticisms of Goy's results made by Völtz and others. Goy claims that peat fed in small amounts is digestible. Völtz claims it has little, if any, value as a feed.

ARTIFICIAL WOOD FROM PEAT.

Danish Patent 17,888, July 2, 1912.—C. R. Steenstrup.

In the manufacture of a hard product from turf masses, the turf is digested in a closed container for about two hours at 148° with 20 per cent. alkali (NaOH) whereupon the mass is washed out. The resulting Na-cellulose is decomposed with an acid or a salt, and washed out. Preferably the humus material is removed by means of NH_3; the resulting NH_4 compound forms a good fertilizer. The solid product may be colored and rendered waterproof by means of an impregnating agent. It may be formed into blocks and plates, and worked like wood after drying.

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FEASIBILITY OF ERECTING BY-PRODUCT RECOVERY PEAT PRODUCER GAS POWER PLANTS IN CANADA.

From a Report on Peat and Lignite made by B. F. Haanel, B.Sc., M.E., Chief Engineer Fuel Testing Division of the Mines Branch, Department of Mines, Canada.

The successful introduction of a peat burning by-product recovery power gas plant into Canada is dependent on the following factors:—

(1) Cost of peat supplied to producer and its nitrogen content.
(2) Cost of labour and labour conditions.
(3) Plant costs.
(4) Cost of sulphuric acid laid down at the plant.
(5) Market for power produced.

The first factor. The cost of peat fuel laid down at the producers and the quantity of peat fuel available, is the most important since if this condition cannot be satisfactorily fulfilled, the feasibility of erecting such a plant requires no further discussion.

From the experience of European plants utilizing peat fuel, the serious difficulties encountered in obtaining the requisite quantity of peat fuel to operate the plant, are fully realized. Not only has it proved a most obstinate problem to manufacture the desired quantities of peat fuel, but, in some instances, almost impossible to deliver the fuel with the proper moisture content to the producers. For this very reason efforts have been made to utilize peat with a high moisture content, but such attempts as have so far been made, have not proved successful. Finally, after the requisite quantity of peat fuel has been manufactured during

the working season of about 3 or 4 months, the question of storing the dry, partially dry, and still wet peat thus manufactured, in such a manner that it will not be ruined by rain, frost, or snow, is one which requires very serious consideration. All of the above problems have arisen in the manufacture of peat fuel in Europe and it can be safely said that all have been satisfactorily solved. In considering, therefore, the establishment of a new industry of this kind in Canada full use should be made of the results obtained with similar plants in Europe.

It has been satisfactorily demonstrated that peat fuel with a moisture content of from 25 to 30 per cent. can be manufactured in Canada during the usual summer season, and in comparatively large quantities. For example, a small Anrep unit of about 25 tons capacity per day of ten hours, has produced as high as 2,200 tons of 25 per cent. moisture peat during the working season of about 90 days. Several such units operating over a large area could consequently produce the required quantity of fuel, and according to the methods followed in Germany at Ostfriesland, this quantity of peat could be safely stored during the winter and rainy seasons.

In Canada, however, the existing conditions are not favourable to the manufacture of any commodity of such low value with a process wholly dependent on manual labour. Processes or methods must therefore, be applied which will render to a certain extent at least, the manufacture of peat fuel independent of manual labour. The process above mentioned, which depends entirely on manual labour, for the performance of all its operations, cannot, therefore. be considered in an undertaking of large proportions, when a large quantity of fuel must be produced at the lowest possible cost.

As a result of the last two season's operations on two Canadian bogs—Alfred and Farnham—there is every reason to believe that the manufacture of peat fuel on a large scale with automatic machinery, is an established fact. No trouble should therefore, be experienced in obtained the required quantity of fuel for a season's operations.

The nitrogen content of the peat fuel, when the peat is burned in a by-product recovery producer, is of no less importance than the winning of the fuel itself, since on this element depends the profitable utilization of the peat. When selecting a bog, therefore, for the manufacture of fuel in connexion with such a plant, great importance must be given to the average nitrogen content of the peat fuel contained in the entire bog. Peat containing less than 1½ per cent. nitrogen in the absolutely dry sample would prove entirely unsuitable for by-product recovery. When considering, therefore, the suitability of Canadian bogs for the manufacture of fuel for the by-product recovery producers, only such bogs will be considered as have a nitrogen content of over one and a half per cent.

Second—Cost of labour and labour conditions. Canada is a new and grow-

ing country, and the many large undertakings always under way demand an ever increasing number of labourers, and naturally when the demand exceeds the supply the wages increase. Other factors, also, are responsible for the high labour wage in North America, but these will not be discussed here. Labour wages in Canada, especially in certain sections, are much higher than obtain in any European country, and for this reason alone, an industry which has proven feasible where cheap labour is plentiful may absolutely fail in a country where the wages are much higher. It is apparent then that economy as regards the number of labourers employed, must be strictly practised in every branch of the industry under discussion. It is the usual custom in Canada to divide a working day of 24 hours into three shifts of 8 hours each, while in Europe two shifts of 12 hours each is often the case.

The number of labourers it is necessary to employ to operate a by-product recovery producer plant continuously may, therefore, exceed that necessary in European practice. In certain localities it might be possible to introduce the 12 hour shift, but in the majority of cases, and in time this custom will become general—an eight hour shift will have to be reckoned with. The daily wages for ordinary labourers differ considerably in the extreme eastern and western portions of Canada. About $1.75 to $2 per day of 8 hours may be taken as the standard wage for ordinary labour in Eastern Canada, while $3 per day obtains, for the same class of labour, in British Columbia and sections of the Prairie Provinces.

Skilled labour demands a much higher wage in Canada than in European countries, but since the number of such men employed in a producer plant will be inconsiderable, the total daily wage account will not be affected to any appreciable extent by this increased wage. In this class of labour is included machinists, engineers, electricians, and foremen.

So in considering the probable profits which are to be derived from the operation of a by-product recovery power gas plant, the fact that labour in Canada is far more expensive than in Europe where such plants are in successful operation, must be given prominent attention.

Third—Plant Costs. The cost of manufacturing machinery in Canada and also the United States is considerably greater than it is in Europe, and its importation from European countries implies a duty of about 30 per cent. of its sale price where made. In some cases it might be found cheaper to import certain portions of the plant and to manufacture others. But when everything is taken into consideration, the plant cost will be very considerably in excess of that obtaining for similar plants in European countries.

The plant costs include buildings, producers and fuel handling appliances, gas scrubbers, ammonia recovery plant, all accessory machinery, such as circulating pumps for acid and water, blowers, machine shop, etc. In addition to these

must be added the power house and equipment if it is desired to utilize the gas generated for power purposes. The cost of the peat bog and peat manufacturing machinery will not be included in the total capital charges against a by-product recovery plant nor will any accessory peat drying apparatus be considered.

The fourth factor which must be considered is the cost of the sulphuric acid used for fixing the ammonia gas. Since approximately 1.1 tons of sulphuric acid of a strength of 60° Baume is required for every ton of ammonium sulphate made, the necessity for keeping its cost as low as possible will be appreciated. At those places where sulphuric acid cannot be obtained at a reasonable cost, some arrangement must be made for manufacturing it at the plant. This in itself might prove, in many cases, an expensive undertaking owing to the comparatively small output required in proportion to the cost of sulphuric acid plant. but if the acid can be manufactured at the plant for a lower cost than it can be obtained from an acid manufacturer such a plant should be installed.

It must not be forgotten that ammonium sulphate sells the world over for between $65-$70, at the present market price, (1913), and that plants established in Canada for its recovery must compete with foreign companies whose manufacturing costs are considerably lower than they will be here. It is, therefore, evident that little or no benefit will accrue, in a financial way, from recovering the nitrogen in the fuel if the costs of the components entering into its composition and those necessary for its recovery are out of all proportion to the gross profits realized from its sale. In certain sections of Canada this may be found to be the case and then such a by-product recovery process cannot be profitably employed in working up a low grade fuel.

The fifth and last factor to be considered, viz. the market for the power produced, is of great importance. It is not probable that many by-product recovery producer-gas plants could be established in Canada for the recovery of ammonium sulphate alone. In the majority of cases, therefore, the sale of ammonium sulphate would only serve to reduce the cost of generating gas and power, and if it failed to accomplish this no advantage, other than from a conservation standpoint, would accrue from its recovery. The main object, then, of establishing such a plant would be the production of a gas to be used for power and other purposes, and this phase of the problem will have to be thoroughly investigated before any such industry is considered.

Canada, especially in its Eastern sections, is well supplied with water powers, and the development of these has of late years been vigorously prosecuted. When a water development is a large and comparatively inexpensive one, electrical power can be developed at a very low figure, and if this power development is capable of supplying all the energy required in the region surrounding, any other power development depending on the combustion of some sort of fuel cannot compete. But if the energy developed at a hydro-electric plant must be

transmitted long distances before being disposed of, its cost to the user will be greater than it is to those nearer the power plant. In such cases the hydro-electric plant may fail and the fuel power plant assert its position. Electric energy cannot be transmitted for long distances even at high voltage without considerable expense and this added to the expense of constructing the power transmission line and substations and transformers may deprive the otherwise cheap power of all its advantages.

A market must, therefore, be established for the power it is proposed to generate before the actual building of a by-product recovery power gas plant is undertaken. If such precautions are taken failure will be prevented, at least in the majority of cases.

MANUFACTURE OF PEAT FUEL.

In order to supply 42,000 tons of absolutely dry peat, or 60,000 tons of 30 per cent moisture peat per year, would require a peat manufacturing plant of large capacity operating on a bog of considerable area. For the purpose under consideration, the bog, it will be assumed, has an area of 1,000 acres, and the length of the season during which manufacturing operations can be conducted will be taken as 100 days.

The quantity of 30 per cent moisture peat that must be manufactured per day of ten hours is 600 short tons. If one peat manufacturing unit, equipped with mechanical excavator and other labour saving devices, is assumed to have a daily capacity of 60 tons of finished peat fuel, then ten such units will be required to manufacture the requisite quantity of fuel, viz., 600 tons per day. If on the other hand the units are operated for two ten hour shifts, then five units will be sufficient to produce the required daily tonnage. If the five unit system is employed the cost of the peat fuel will be decreased by an amount proportional to the interest, amortization, and depreciation on the capital cost of the extra five units. To be on the conservative side, however, the larger number of units will be considered.

CAPITAL COST OF PEAT MANUFACTURING PLANT.

Peat bog, 1,000 acres at $10 per acre	$ 10,000.00
10 peat manufacturing units complete with conveyor system, automatic spreaders, etc.	120,000.00
2 peat sheds of 2,000 tons capacity each	10,000.00
Locomotives, tracks, etc.	10,000.00
Portable transmission line to cover entire field of operation	10,000.00
Draining and preparing bog for manufacturing peat	10,000.00
Ten houses for boarding and lodging 140 labourers	20,000.00
Total	$190,000.00

LABOUR, MANAGEMENT, AND OTHER COSTS.

140 men at $2 per day for 100 days	$28,000.00
1 manager at $1,800 per year	1,800.00
2 superintendents at $5 per day	1,000.00
Power, 500,000 H.P. hours at .005 cents a H.P. hour	2,500.00
Lubricants, etc.	3,000.00
Repairs	6,000.00
Interest, amortization, and depreciation on capital	26,600.00
Total	$68,900.00

Quantity of fuel manufactured 60,000 net of run 30 per cent moisture peat.

Cost per ton $\frac{68,900}{60,000}$ equals $1.15. Cost of peat per ton, $1.15.

The above cost of $1.50 per ton delivered at the producers is considered a very conservative figure when operations are conducted on a scale as large as those outlined above. Actual operations might demonstrate that this cost can be materially reduced.

The cost of the entire equipment, including gas producer, power and peat getting plant, the writer believes is on the high side, and that the probable results are, therefore, conservative.

In light of the results obtained in Germany on the Wiesmoor, no serious trouble should be encountered in the storing of even this large quantity of peat fuel.

No mention was made concerning the utilization of the heat of the engines exhaust for steam raising; that this would be done was taken for granted. Too much stress cannot be laid on the importance, and even necessity, of introducing every possible economy into the operation of a plant of this description. The fuel must be handled mechanically, if possible, from the field to the producer bunkers, and all unnecessary labour dispensed with.

Since 60,000 tons is the net quantity of fuel required to operate the plant 350 days at full capacity, a larger quantity of fuel must be manufactured to provide a margin for unforeseen contingencies. The peat manufacturing units, it is assumed, are capable of meeting this extra requirement.

A sulphuric acid plant would have to be built in almost any case, since this commodity if bought in quantities from some independent manufacturer and transported to the power plant at the bog would prove too expensive when the operations are conducted on so narrow a margin. The writer believes that sulphuric acid can be manufactured for the price stated above, viz., $8 or less in almost any place in Eastern Canada favourably situated with respect to railway or water transportation.

The costs of plant, operation, management, etc., which the writer believes are quite liberal, cannot be taken as being exact. They are approximate and are

only intended to serve the purpose of pointing out the probable use to which some of the Canadian peat bogs might be put. Every locality, where the erection of such a plant is contemplated, must be studied separately, since no definite costs and probable profits can be stated to cover all cases; moreover the costs of such a plant manufactured either in England or Canada must be obtained from the builder.

The minimum capacity of the plant should not be under 100 tons of absolutely dry peat per twenty-four hours. Owing to the high plant and operating costs in this country a plant of small capacity would not prove profitable except in cases where the content of nitrogen is very high. An increase in the nitrogen content of the fuel will, of course, permit a further reduction in the cost of generating power and thereby make a plant of smaller daily capacity a profitable venture, in fact there are cases where a satisfactory profit could be made on the manufacture of ammonium sulphate alone. The minimum nitrogen content with which satisfactory results can be obtained may be put at 1.5 to 1.75 on the absolutely dry sample. There are several bogs suitable for the manufacture of fuel which contain 2 per cent nitrogen and over, but the larger number of such bogs contain a considerably less amount.

UTILIZATION FACTOR.

In the above estimate of the cost of producing one kilowatt and one horse power year the ratio of the average yearly load to the installed capacity of the plant, i.e., its utilization factor, was not taken into consideration. The maximum efficiency of a gas engine installation is realized when the engines are operating at full load, and for this reason, it was assumed for purposes of arriving at a probable cost of generating power, that the power plant would operate continuously at full load. This will never be the case in practice unless the load is so arranged that the gas engine units will carry the constant portion and the variable or peak portion is carried by an auxiliary steam unit or extra gas engine units, or else the entire output is sold en bloc and retailed by the purchaser.

Certain kinds of work require a uniform load during several hours of the day while others will take a uniform load during 24 hours. But there are other demands for power, and these are in the majority, which are fluctuating.

In order, therefore, to meet the various demands made on the plant and at the same time operate the gas engine units at their full rating, an auxiliary steam plant seems advisable. This auxiliary plant should preferably be a steam turbine. On account of the great flexibility of steam engines in general, but especially of steam turbines, the momentary load carried may be far in excess of the rated capacity of the machine. One such unit might, in all probability, be sufficient to meet the peak demands on the plant.

A steam boiler will also have to be provided and this should be, preferably, gas fired.

The gas for this purpose might be generated in a spare producer unit, which can lie over during the greater part of the day. The consumption of fuel in such a case would not be considerable during the stand-by. The advantage of this method of firing the boiler is the recovery of the nitrogen of the peat burned when the steam plant is in operation, which would be lost if the peat were burned directly under the boilers. A sufficient quantity of gas for keeping the boiler in steam during idle periods might be obtained from the general gas plant.

A load factor less than unity will considerably increase the cost of power. Thus a load factor of 50 per cent. will increase the cost of generating a horse power year from $12.63 at full load, and when the nitrogen content is 1.95 per cent to $25.20.

GENERATION OF STEAM FOR PRODUCERS.

This quantity of steam is very considerable, about 2 lbs. per lb. of dry fuel burned, so that a gasification of 5 tons of absolutely dry peat per hour would necessitate a quantity of steam for the producers alone of about 10 tons. Unless all of the waste heat of the plant is utilized for steam raising, the larger portion of this quantity will have to be raised at the expense of the power gas, which would necessitate a reduction in the power developed.

The sources of heat which must be utilized for saturating the air blast and generating live steam are: the sensible heat of the producer gas; heat of boiler flue gases; and heat of the gas engine's exhaust steam from blower pumps, etc., in addition, the tar resulting from the process must be recovered and burned under the boilers. The introduction of such economies as those enumerated will appreciably increase the over-all efficiency of the plant and render available a larger quantity of gas for power purposes.

PRODUCER GAS FOR HEATING PURPOSES.

In certain cases it might be advisable to distribute the power gas generated, in mains to nearby manufacturing towns, or cities, for heating and other purposes. Such a disposition of the gas generated is made at the large Mond by-product recovery power gas plant at Dudley port, Staffs, England.

CANADIAN PEAT BOGS AS A SOURCE OF FUEL FOR THE PRODUCTION OF GAS IN THE BY-PRODUCT RECOVERY POWER GAS PRODUCER.

The results of previous investigations have conclusively demonstrated that peat fuel can successfully compete with coal for the production of power in the non-by-product recovery gas producer, when the cost of coal at the producer is in the neighbourhood of $4 per ton and peat containing 25 per cent moisture costs not more than $2 per ton. This, of course, applies to the utilization of the two fuels in the same manner. When power produced from peat in a power gas plant is compared with that generated from coal in a steam power plant the

advantage lies very much in favor of the former. When, therefore, a power plant is required to serve a district where cheap hydro-electric power is not available, such a peat producer gas power plant will economically answer the requirements, provided of course a suitable peat bog is situated within the district in question.

Unfortunately many localities do not exist in Canada where such conditions obtain. In the first place the various Provinces are more or less sparsely settled in and those districts which are thickly populated, and where industries of various kinds abound, water power is available in more or less large quantities. In still more thickly populated districts peat bogs of suitable proportions and quality are not situated within a reasonable distance. The opportunities, therefore, for developing on a large scale such a power plant designed exclusively for the use of peat fuel are not many, since such a power plant, to prove a feasible undertaking, must be able to compete with existing sources of power and at a profit.

This phase of the utilization of peat can therefore be dispensed with in the consideration of those cases requiring the production of energy on a large scale, even though its successful application might be found in a few isolated cases where small powers are required.

BY-PRODUCT RECOVERY PRODUCERS.

If the cost of generating power with a producer gas-power plant can be decreased by any means to such an extent that it is capable of competing successfully with other forms of cheap energy, its field of application will be greatly increased. The hopes of investigators and of those desirous of converting into some useful commodity the immense quantities of peat now lying dormant, were materially raised when the Mond process for the gasification of low grade fuels with by-product recovery was devised. But while this process, when applied to peat fuel, possesses many inherent advantages and does in many cases materially decrease the cost of generating power, its field of application is also limited. The main difficulties encountered in the generation of power in a producer gas power plant may be enumerated as follows: First, the maximum economy is realized only when the producers and gas engines are operating at their maximum load, and, secondly, the inability of the gas engine to carry over load. For these reasons a producer gas power plant would not prove suitable for a service subject to extreme variations in the daily loads or where the utilization factor is very low. In the former case the gas engine plant would have to be supplemented by a steam plant which would carry the over load or else the gas engine units would have to be increased out of all proportion to the capacity for which the plant is designed. In the latter case the economy resulting from the use of gas engines would be entirely lost if the load or utilization factor is very much less than unity, since the maximum economy is only realized when the engines are running at their normal rating, and if a large percentage of the power units are lying idle

a considerable part of the time, the fixed charges will be too large to permit of the economic production of power. The most desirable and ideal conditions are met with when the load is of such a character that the gas engine installation can operate at full or nearly full load during the greater portion of the day, all excess demands being taken up by either an extra gas engine unit or else an independent steam turbine unit. Another possible but not quite practicable solution to the problem is the installation of a storage battery plant of sufficient capacity to absorb the load when the engines are running light and of supplementing with this stored energy the power units when the extra or peak demands arise. Such a solution, though it would in almost every way meet the requirements necessary for the most economical operation of a gas engine power plant, would prove impracticable on account of the high initial cost and consequent upkeep of the storage battery system. This case cannot therefore be considered at this moment.

The advantages, moreover, resulting from the recovery of by-products such as ammonia and tar, are more apparent than real, since the economies resulting from their recovery are dependent on their cost at the plant and their disposal at a reasonable market price. It is quite probable that ammonium sulphate prices will continue firm at existing or higher levels for some time to come, but its cost of manufacture is somewhat uncertain, due to the uncertainty of supplying the raw materials required for its manufacture at a sufficiently low price, and this alone in many localities might militate against its recovery with a reasonable profit. The market for the tar produced is also very uncertain; if it is reduced to pitch by subsequent distillation its market price will be considerably enhanced, but even under these conditions a material of so low a grade cannot stand long haulage. But it is hardly necessary to consider the tar produced as a by-product since in most by-product recovery producer gas plants the tar is burned under the boilers of the plant, and this particularly is the case in the peat burning plants. This then leaves ammonium sulphate as the only by-product recovered which can serve to materially decrease the cost of generating power.

Although plants of this description have been erected for the sole purpose of generating power from peat, only one, to the writer's knowledge, is in successful operation at the present time. The reasons advanced for the failure of the others are not satisfactory, for example, the difficulty of supplying the required quantity of peat with a sufficiently low moisture content and a satisfactory nitrogen content are cited as the cause of failure in one case. The principal cause for the unsuccessful termination of these ventures, is in the writer's opinion, due to the fact that insufficient consideration was given to all the details on which the successes or failure of the project depends. Before deciding upon the erection of any power plant for the utilization of peat fuel, full particulars of the bog both physical and chemical should be obtained and fully considered. If this course is

followed, a plant will not be erected on a bog unsuitable for the manufacture of fuel and where the average nitrogen content is too low to permit of the profitable recovery of ammonia. It is not difficult to determine whether a bog is suitable or unsuitable for the manufacture of peat fuel and how large a quantity with the desired moisture content can be manufactured during the usual summer season. If the bog be a wet one and difficult to properly drain or its drainage should prove too expensive, then it should be abandoned and a new one searched for. Great care, moreover, should be taken to obtain the most accurate results concerning the average nitrogen content of the entire bog, since any variation will materially affect the financial results it is expected to obtain. After a bog suitable in every respect for the manufacture of peat fuel with the desired nitrogen content has been selected, the conditions governing the sale of electric energy within the region surrounding the bog should be most carefully investigated. If the results of such investigation prove promising the erection of the plant may be safely undertaken. Today, most of the factors which determine the ultimate success or failure of any enterprise of this description are well understood. The difficulties, e.g., encountered in the manufacture of peat fuel on a large scale are well known as are also the methods of overcoming them, and no mistake should be made concerning the maximum moisture content of the fuel permissible. This phase has been thoroughly investigated and requires no further experimenting If it be decided, in any case, that the required quantity of fuel with a maximum moisture content of forty per cent cannot be manufactured at a cost of under two dollars per ton delivered at the producers, then the project should be abandoned.

As previously stated, there are many bogs suitable in every detail to the manufacture of peat fuel for gasification in by-product recovery producers which are situated in districts already supplied with cheap electrical energy, the utilization of the peat content of such bogs for power purposes is, therefore, manifestly not feasible except in a few isolated cases. All of the gas manufactured for industrial and domestic purposes in Canada, with the possible exception of coke oven gas, is largely "retort" or "town gas," and this is dependent in the larger number of instances on coking coal imported from the United States. In the manufacture of "town" or "retort" gas only the volatile matter in the coal is gasified, the fixed carbon remaining in the retort as coke. Coke is, therefore, a by-product which meets with a ready market in most large cities and towns, and contributes towards a reduction of the manufacturing costs of the gas. In addition to coke a small amount of ammonia and tar is formed. The maximum quantity of ammonia resulting in any case is only a small percentage of that theoretically possible. The recovery of ammonia does not therefore contribute very considerably towards the economy of the process. The average quantity of retort gas produced per ton of coal (2,240 lbs.) is 11,000 cubic feet or 10,000 cubic feet per short tons (2,000 lbs.), and its average heating value is about 560 British thermal

units per cubic foot. In the case of gas generated from peat in a Mond by-product recovery producer the quantity of gas available for power or other purposes produced per ton of absolutely dry peat is about 67,000 cubic feet and the heating value may be put at 140 British thermal units per cubic foot. One thousand cubic feet would in this case represent a heating value of 140,000 British thermal units or 25 per cent of the "retort" gas.

The quantities of "retort" gas made from coal and of producer gas generated from peat which are equivalent in heating value to one short ton of coal with a heating value of 12,500 British thermal units per lb. are 45 thousand and 179 thousand cubic feet respectively. 2.67 tons of absolutely dry peat of a heating value of 9,000 British thermal units per lb. would be required to produce 179 thousand cubic feet of gas, and if the cost of peat containing 30 per cent moisture laid down at the producer is $1.50 per ton or $2.13 dollars per ton of absolutely dry peat, the cost of the fuel alone, required to produce 179,000 cubic feet of gas would be 2.13 x 2.67, equals 5.70 dollars; while in the case of "retort" gas 4½ short tons of coal of a heating value of 12,500, or over, British thermal units per lb. would be required to produced 45 thousand cubic feet of gas with a heating value of 560 British thermal units per cubic foot. If the cost of gas-making coal laid down at the gas retorts is assumed to be $2.50 per short ton, the fuel alone would be 2.50 x 4.5, equals 11.25 dollars, about twice as much as with peat. The by-products obtained in the "retort" gas process are coke—principally—ammonia and tar; while in the case of the producer gas plant, ammonia and tar constitute the by-products. The following calculations show the costs of the fuel required in the "retort" process using coal and the "Mond" process using peat to produce a quantity of gas equivalent in heating value to one short ton of coal with a heating value of 12,500 British thermal units per lb. The cost of recovering the ammonia produced with the Mond process is taken from the estimated costs of operating a 120 ton Mond plant burning peat fuel.

RETORT GAS.

PRODUCTS RESULTING FROM THE GASIFICATION OF ONE SHORT TON OF COAL

Illuminating gas, 10,000 cu. ft.—heating value 560 B.T.U. per cu. ft.
Coke, 1,100 lb. about.
Sulphate of ammonia—20 lbs. (nitrogen content of coal 1½%).
Tar.

FUEL COSTS.

4½ tons of coal at $2.50 per ton		$11.25
By credit, gross profit from sale of 4,950 pounds of coke at $5 per ton	$12.37	
And 90 lbs. Sulphate of Ammonia at $65 per ton	2.92	
About		15.30
Net cost of coal, exclusive of manufacturing and other costs		—$4.05

MOND PRODUCER GAS.

Products resulting from the gasification of one short ton of absolutely dry peat with a heating value of 9000 B.T.U. per lb.

Gas 67,000 cu. ft. heating value 140 B.T.U. per cu. ft.

Sulphate of ammonia—128 lbs. nitrogen content of peat, 1.94 per cent.

Tar.

FUEL COSTS.

2.67 tons of absolutely dry peat at $2.13 per ton	$5.70
By credit 2.67 x 128 lbs. of sulphate of ammonia, net profit from sale of, exclusive of cost of fuel	11.00
Net cost of fuel, exclusive of manufacturing and other costs	—$5.30

When operating under the conditions of peat costing not more than $2.15 per absolutely dry ton, and gasifying at the rate of 120 tons of peat containing 1.94 per cent nitrogen, per day of 24 hours, it is possible to produce the gas free of cost, while the cost of the "retort" gas would include in addition to the net fuel costs, operating and fixed charges, which are very considerable.

Four thousand cubic feet of producer gas would have to be supplied for every 1,000 cubic feet of "retort" gas in order to supply the equivalent heating value.

A producer plant capable of gasifying 120 tons of absolutely dry peat per day would generate 335,000 cubic feet per hour when running at normal capacity. This, however, could be considerably increased for short periods. A plant of this capacity could meet all requirements, both industrial and domestic, of several towns and villages. The gas could be profitably used for heating houses as well as for supplying the other domestic demands for heat.

In estimating the costs of one or the other plants only the actual cost of the gas plant need be considered, for purposes of comparison, since the gas mains in the one case will serve for the other. If the gas mains are already laid and are designed to transmit town or retort gas, then, since four times the quantity of producer gas must be forced through the mains, the pressure will have to be increased. The Canadian peat bogs, which might be profitably utilized in this manner, are those which have a high nitrogen content in addition to a satisfactory heating value. They must also be situated reasonably near towns or cities of sufficient size to consume all the gas generated. The following bogs will be cited as examples, on account of their satisfactory nitrogen content, to merely point out the possibilities in this direction:—Brockville, Holland, Large Tea Field

and Small Tea Field. There are many other bogs suitable for the manufacture of peat fuel but which do not contain a sufficient quantity of nitrogen to render its recovery profitable.

PEAT IN THE MANUFACTURE OF PAPER.

(Translated from "La Papeterie Francaise).

The use of peat for paper manufacturing purposes was suggested long ago, and paper industry periodicals have many times published patents relating to this subject.

Canada is one of the papermaking countries most interested in the use of this raw material, as the area of peat bogs there exceed 30,000,000 of acres, or 10,000,000 more than in the U.S., and more than any European country, except perhaps Russia. Many different methods have been suggested for utilizing the peat; as fuel, as gas producer, as raw material for the manufacturing of alcohol, as litter, as packing material for fruit, etc.

Previous experiments in using it for papermaking purposes however don't seem to have given very encouraging results from an economical standpoint, either with peat alone or mixed with woodpulp. The lack of success met with may be explained by several reasons. Several authors describe quite seriously digesting methods with soda or other chemicals under high pressure, sometimes followed by a bleaching with chloride of lime. The only result of such methods is the rapid vanishing of the capital engaged without any hope of future profits.

It must be remembered that the general term "peat," includes a great variety of vegetable substances, which have been submitted to a more or less advanced decomposition in the ground. It is evident, that a peat can give promising results or be immediately rejected, depending upon, if it is of recent or old formation, or upon which organic substances it contains. In this manner the peat from the very vast bogs near Amiens (France), has been found impossible to utilise in any industry. Its state of decomposition is too advanced, and it crumbles to pieces when dry. Such peat may be used as a fuel and give gas by distillation; perhaps it may have other uses, but not for paper-making.

Another kind of peat, however, occurring, for instance in the department of Basses-Pyrenees, has been experimented with and can certainly take a place among the raw materials for papermaking.

In most peat bogs there exists at a certain depth below the surface, 2—7 ft., sometimes a layer of only slightly decomposed peat, in which the constituent elements of the plants are found, only a little changed. Below this layer the peat is decomposed, darker, and cannot be used for papermaking purposes.

In the experiments in question only the manufacture of cardboards was tried as the peat seemed to be less suitable for paper manufacture, perhaps with exception for certain very dark-colored tar-papers.

The peat was used as it was taken from the bogs, without previous washing. It may be remarked, that it contained very little earth and extraneous matter. The washing of peat gives a very dirty, dark-colored wash-water, which cannot be let out into rivers or lakes, as this would cause complaints and difficulties.

The author simply refined the raw peat a little in order to cut off too long fibres, and to beat up certain roots, somewhat coarse; he added digested straw pulp, about 50 per cent, and obtained a cardboard of an agreeable brown color, both strong and pliable. Its strength was certainly superior to cardboard made only of straw. He also obtained a satisfactory product by mixing 50 per cent of peat with 50 per cent of old paper.

The experiments were executed on a very small scale and no advices as to results obtainable on a manufacturing scale can be given. It, however, seems as if the kind of peat used when only a little decomposed could very well be used for cardboards without any digesting. The screening surface, of course, must be large and continously cleaned. The riffler also must be of ample dimensions.

It may be advisable to use the water passing through the wire over again, in order to have as little as possible to discharge in the river. The wire ought to be long and the speed slow on account of the high proportion of very short fibres, and also because some the fibres possess a remarkable degree of "greasiness." The natural color of the peat does not permit manufacturing of light-colored boards, at least only if a very small percentage is used.

From an economical point of view the use of peat under the stated conditions seems interesting on account of its cheapness. It is impossible to give a price for peat here, as it mainly depends upon local conditions. The mechanical extraction seems possible, but the problem is far from being solved for peat only a little decomposed and still rich in fibres, which cannot very well be taken from the bogs by means of excavating machinery.

Extraction by hand is laborious and expensive. On the other side, if the peat is utilized on the spot, it is not necessary to dry it, but for transport an air-drying is indispensable, as the percentage of water often reaches 95 per cent.

The peat is a raw material, notwithstanding all this, which the cardboard manufacturer in certain regions can obtain cheaply and which can be useful to him; mixed with straw pulp or old paper it will give, if sufficiently fibrous, cheap cardboards of good quality.—*Pulp and Paper Magazine.*

PRODUCER GAS FROM LOW GRADE FUELS.

R. H. Fernald.

Due to the great consumption of coal in this country, it is estimated from reports of the U. S. Geological Survey that, if the rate of increase of fuel con-

sumption that has held for the past fifty years is maintained, the supply of easily available coal will be exhausted before the middle of the next century. As a matter of fact, the fuel consumption per capita is actually increasing much faster than the population, so that the question of the continuation of this rate of increase is one of considerable importance.

In view of the necessity of utilizing for the production of power grades and varieties of fuel which until recently have been considered uneconomical, the U. S. Bureau of Mines has conducted a number of investigations on the making of producer gas from such fuels.

Introduction of the gas producer into this country for power plant work was made about the year 1900. While the number of installations in that year was no more than four, in 1911 it was estimated that this figure had increased to from 650 to 700 and of these a large proportion were double installations, which were not counted separately. Today, the number of gas producer power plants in this country is in the neighborhood of 1000. Total increase in horsepower of these plants has been from 2000 in 1900 to 170,000 h.p. in 1911, some 85,000 of which was obtained from bituminous coal, 75,000 from anthracite, and about 10,000 from lignite.

The heat losses in typical steam and gas power plants are estimated as follows:—

	Heat losses per cent.	Net efficiency per cent.
Steam plant	95.30	4.70
Gas plant	81.20	18.80

Original heat of coal in both plants equalled 13,500 B.t.u. per lb.

It is evident from above figures that as far as net efficiency of the plant is concerned the gas plant is far ahead of the steam plant.

Several types of gas producers are now in use, among them the suction type, the up-draft pressure type, the down draft type and the double zone type.

Gas produced by the use of air and carbon only has certain excellent qualities for power purposes, but is rather low in heat value, and in making such gas there is a tendency for the temperature to rise to such a point that excessive clinkering is produced and fuel troubles are caused. Introduction of water or steam keeps the temperature at a sufficiently low point to prevent clinker formation.

Getting rid of the tar, after it is removed by some form of tar extraction, is a serious problem, and many attempts are being made to effect an increased utilization of this product commercially.—*Journal of the Franklin Institute.*

POWER PROBLEMS IN ELECTROCHEMISTRY.

(Extracts from a paper read by P. W. Sothman, C.E., formerly Chief Engineer of the Ontario Hydro-Electric Commission, at the Twenty-fifth General Meeting of the American Chemical Society, New York, April 16, 1914).

This is an age in which we have become accustomed to utilize electricity in some manner in practically every walk in life. Not only is it employed to solve difficult problems in manufacturing, transportation and mining, but it has been trained to serve our domestic needs in the household, and even to lighten the burdens of the agriculturist. It is not surprising then, to find it a fit companion to labor hand in hand with the great science of chemistry, so aiding in the accomplishment of gigantic results for the benefits of mankind which a few years ago would have been deemed impossible.

Inspiring as are these things when viewed in the abstract, we are, nevertheless, aware that they have not come about by themselves, or, like Topsy ,"just growed," but are the result of long years of experimentation and study by many different investigators. Nor can we for a moment believe that we have arrived at a point where no further or new applications of electricity are possible. Each day reveals to us wider possibilities in the art, and the electrochemical field is no less prolific in these new developments than the other branches of electric science.

The uses of electricity have multiplied so rapidly during the past few years that it has come to be the concern of many of us at least to find means for applying power in the form of electricity in large quantities and at such a price that it will be economically available for the uses in hand. Moreover, in many instances we can find power existing in the primitive forms of waterfalls, coal and peat beds, or oil fields, the location of which are not suited to power utilization on the site, and transmission becomes a necessity.

The principal means for the generation of electrical energy are steam, waterfalls, gas producer plants and oil engines. Plants of each type are common, although the last two have not yet been used in connection with large installations to any extent. It is the writer's feeling that a great opporunity lies in this for the economical production of power, and that the time will shortly arrive when we shall see these competitors of steam and water power take a very prominent part in electrochemical work. . . .

In some lines, such as the manufacture of tools and also cotton and woollen goods, the power used is slight, and the power cost is a comparatively small portion of the whole, hence the actual price paid per kilowatt hour for energy, whether high or low, does not influence to any great extent the cost of manufacture. On the other hand, in certain industries like pulp and paper mills, the

horse-power used per employee is large, and the cost of power forms a large percentage of the total cost. In electrochemical processes, we know that power forms one of the chief items of expense of operation, and it is of great importance to have a source of power for electrochemical work which shall not only be cheap at the present time, but which will continue to be cheap for a reasonably long period of years, notwithstanding the encroachment of demands for power by other industries which can easily afford to pay a higher price for it. . . .

There is at the present time a matter of considerable interest in this connection, and that is the latest development in the gas power situation, namely, the use of engines operated by gas obtained from peat. It can easily be shown that the peat fields distributed over large areas of this country are far more valuable to our power supply market than all our water powers, and, as water powers are frequently susceptible to severe interruptions, the utilization of peat as a fuel producer is worthy of consideration. It may even be that, in time to come, water power and peat power plants will be operated jointly, furnishing us with a permanent supply of energy, for, while water power plants may suffer during severe winter weather, the supply of energy obtainable from peat is always available.

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The present issue of the Journal has been delayed in order to include the extracts from the report of Mr. B. F. Haanel on the feasibility of erecting peat producer gas power plants in Canada, which occupies a position of prominence in the number.

Complying to the request of a petition presented by members of the Peat Society and others interested, the Minister of the Interior some time ago authorized the sending of Mr. Haanel to Europe to report upon the progress

made there in the establishment of peat producer gas plants devoted to production of power, with or without recovery of by-products. During the course of the investigation Mr. Haanel, with his assistant Mr. Blizard, visited the Mond by-product recovery power gas plant at Orentano, Italy, the works near Osnabruck, Germany, and several other plants. His detailed report, illustrated with cuts, maps, explanatory curves, etc., has just been issued and will prove a perfect mine of valuable information to all who are in any way interested in the development of our peat resources. We hope at an early date to epitomize the report for the benefit of such of our readers who may not be so fortunate as to secure a copy of the report itself.

The past year, while it has proved disappointing from the standpoint of actual production of peat fuel in Canada has seen substantial progress towards the solution of what is undoubtedly the crucial difficulty in the way of establishment of a peat fuel industry on a large commercial scale in Canada.

Any attempt to transplant European methods and plant to this continent which is to prove in any measure successful, must be made with full recognition of the additional burden imposed by our much higher labour costs.

The Anrep plant and process demonstrated by the Government at Alfred must be regarded as the most practical and efficient yet devised under European conditions, and the best suited to these conditions. This is amply demonstrated by the remarkable progress of peat fuel manufacture in Russia, where hundreds of plants of a character similar to that erected by the Government at Alfred, Ont., have been installed in the past few years and where the annual production is reported to have grown from 2,500,000 metric tons three years ago, to 7,000,000 metric tons last year.

It has always been recognized by the Government Department, which carried on the demonstration at Alfred, that the scope of the plant there employed would necessarily be somewhat restricted in this country owing to the amount of hand labour involved. Dr. Haanel in an address before the Toronto Canadian Club in 1911 urged the necessity of substituting mechanical energy for much of the hand labour, and among other things said:—

"The Government plant at Alfred serves the purpose of demonstrating the manufacture of air-dried machine peat, and is suitable to be operated on bogs near villages, or by groups of farmers who own peat lands and who are desirous of making their own fuel, as a cheap and excellent substitute for the high-priced coal which they are now obleged to purchase. For the manufacture of peat on a large scale, mechanical excavators, spreaders, and cutters should replace the manual labour employed at our plant."

Following the operation of the Government demonstration plant, our President, Mr. Shuttleworth, undertook to install at Alfred, new and larger plant

utilizing mechanical devices, and with a large capacity per annum. The development of the required equipment occupied the better part of two seasons. In 1913 Mr. Shuttleworth was unfortunately called away to England and this year the burden of completing the plant fell on the shoulders of Mr. E. V. Moore, the engineer in charge, and gentlemen with whom he associated himself. The early part of the season up to July was occupied in replacing temporary with permanent steel construction, and actual production was only fairly begun when the outbreak of the war interfered seriously with the financing of operations.

While, therefore, only a very short season was devoted to production, and the output was small, it was the feeling of all who saw the plant in operation that the numerous mechanical difficulties had been practically overcome, and that the new plant gives every promise of affording a successful solution of the manufacture of machine peat on a commercial scale in Canada.

During the year enquiries were made by British capitalists looking to the erection of extensive chemical works in Canada for the utilization of peat as soon as a sufficient annual production can be guaranteed. With the difficulties so far overcome as at present, and with the erection of additional units, there seems every reason to anticipate that this objective will be reached in the near future, and we shall see a substantial peat industry established in Canada at an early period.

An article in the July, 1914, issue of the Journal, taken from the Journal of the American Peat Society, referred to several experiments made in the United States in pumping peat from wet bogs to the drying ground in a more or less liquid state.

We are in receipt of a catalogue describing the "Stereophagus" Pump, a centrifugal pump of special design, invented by the Hon. R. C. Parsons, M.A., M.Inst.C.E., and manufactured in England, for dealing with all kinds of liquids containing fibrous or solid matters, which is claimed by its makers to be well adapted for the pumping of peat.

The impeller or fan differs from that of the ordinary centrifugal pump by being made conical instead of cylindrical, the liquid being admitted to it on one side only. Owing to the special construction of the pump any solid obstacles are cut into pieces small enough to pass through the passages between the impeller vanes and the conical casing and no solid matter can lodge in the interior of the pump.

The "Stereophagus" pump has been successfully used in pumping sewage, and is claimed to be specially suitable for pumping water used for conveying large quantities of solid or fibrous matters such as paper or wood pulp, brewers' grains, etc. Pumps are made to be made with suction and discharge pipes ranging from 3 to 12 inches in diameter, and delivering from 150 to 4800 gallons per minute.

PEAT INVESTIGATIONS IN THE UNITED STATES.

To extend and strengthen the field of its graduate work in engineering the University of Illinois has since 1907 maintained ten Research Fellowships in the Engineering Experiment Station, for each of which there is an annual stipend of $500, open to graduates of approved American and foreign universities and technical schools. Not more than half the time of the Research Fellows is required in connection with the work of the department to which they are assigned, the remainder of the time being available for graduate study.

The Engineering Experiment Station, an organization within the College of Engineering was established in 1903 for the purpose of carrying on investigations in the various branches of engineering, and for the study of problems of importance to engineers and to the manufacturing and industrial interests of the State. Research work may be undertaken in architecture, architectural engineering, chemistry, civil engineering, electrical engineering, mechanical engineering, mining engineering, municipal and sanitary engineering, physics, railway engineering, and in theoretical and applied mechanics.

During the coming year important work in the investigation of peat and peat products will be carried on, and arrangements have been made through this Society to provide samples of Canadian peat and peat fuel for the purpose of such investigations.

Samples of Canadian peat and peat fuel have also been sent to the Mellon Institute of Industrial Research in connection with the University of Pittsburgh, where similar research work is being carried on .

In view of the important role which technical education and research work are likely to play in the development of Canadian industries during the next few years, and of the many possibilities connected with the utilization of our extensive peat resources, it may be hoped that some of our Canadian universities may see their way to undertaking investigations and research work along these lines in the near future.

Save your ashes. There is another scheme on to burn them. This time it is "Calorigene," and news of it comes out of the North. The Ottawa Free Press hails it as a "timely discovery," and says it will burn up seventy-five per cent. of the ash, and effect a saving of twenty-five to fifty per cent. of the coal, in which case from one to two-thirds of the coal would seem to need to be ash, unless the ash has more heat value than the coal itself.

The timeliness of the discovery, or of the announcement, to our mind, lies in the fact that the public has had just about time to forget Doctor Hoy and the

Cobbler of Scranton. It was about seven years ago that they set the engineering world by the heels with their announcement that a solution of salt and oxalic acid would make a fuel bed out of an ash heap. Thousands of engineers all over the country set out to burn up their ashes. The Board of Education of New York City laid in a stock of the chemical and made the janitors use it. Quite a bit of unburned carbon which had found its way into ash barrels was saved by the second burning, but in the last analysis it was found that such of the so-called ash as was burnable was carbon and would burn without the aid of the cobbler's compound, and such as was really ash was beyond resuscitation. The cobbler presumably went back to his last, and the doctor who financed the scheme shot himself.—*Power.*

PEAT AS A METALLURGICAL FUEL.

Peat is a material that has long been used as a domestic fuel, especially in Ireland, whose peat bogs are famous. In America its use has never been extensive, largely for the reason that better fuels have almost everywhere been available. Attention is, however, now being directed to the utilization of peat as a fuel for various industrial purposes. Carl G. Kleinstueck, vice-president of the American Peat Society, is credited with responsibility for the statement that in its peat beds the northwest, especially Michigan and Minnesota, has a fuel resource of far greater value than its mines. This is a pretty strong statement, but we pass it unchallenged. It at least serves to call attention to natural resources, whose importance, or potential importance, is little realized.

In a paper read before the Duluth meeting of the American Peat Society, Dr. Peter Christianson calls attention to some of the possibilities of peat as a metallurgical fuel, especially in the iron and iron-ore industry of the Lake Superior iron district, that is, in the beneficiation or preliminary treatment, and in the smelting, of the ore.

Peat is a low grade fuel and must be utilized close by where it is produced as it will not bear the cost of transportation. A peat power plant should be located at the peat bog, the peat being used in a gas producer to generate producer gas for the operation of gas engines for driving dynamos. Power thus generated may be used for operating concentrating and other machinery. It can also be used as a fuel in drying, roasting, calcining and sintering operations.

Experiments made at the Minnesota Schools of Mines Experiment Station show that finely divided iron ores when mixed with peat and briquetted, when heated in a reducing atmosphere, as in a blast furnace, hold together. Further experimental work to determine the mechanical and physical properties of these ore-peat briquettes is being done.—*Mining and Engineering World.*

PATENTS RELATING TO PEAT ISSUED BY THE CANADIAN PATENT OFFICE.

159,843, Dec. 29, 1914—Ernest V. Moore, Peterboro, Ont.

Peat Spreading and Briquetting Machine

The object of the invention is to provide a simple and durable machine which will travel along the ground and deposit the briquetted peat in a thin layer behind it for drying, which will continuously form peat briquets of uniform size and consistency, and which may be fed from a conveyor at any point of its travel.

The device consists essentially of a framework having at the rear a transverse trough in which a distributing screw operates. At the rear of the trough are a number of moulds. The machine is propelled by a suitable motor, which also furnishes power to operate the briquetting apparatus. The peat is transferred from the distributing trough to the moulds by a number of revolving screws or worms, which operate alternately in opposite directions and intermesh.

The framework of the machine rests on caterpillar treads. On a platform between these a suitable motor is mounted and connected to operate the caterpillars, which may be moved independently. or one faster than the other, so as to guide the machine. If the motor is of the electric type, as shewn in the drawing supplied, trolleys are used to make power for operating from overhead wires.

Toward the rear of the machine a transverse trough is provided having a removable cover, and provided at one end with a hopper. Within the trough a large screw or worm, tapering away from the hopper, extends from end to end thereof.

On the rear side of the trough at the bottom an outlet passage extends from end to end, opening into a plurality of rearward discharging moulds, which may be slightly tapered towards their outlet for the purpose of concentrating the peat, and otherwise modified as may be desirable to vary the form of the briquets.

In this passage a number of screws or worms are provided, arranged at right angles to the distributing worm, and operated alternately in opposite directions. These are located centrally in line with each mould, but are of greater diameter than the moulds, so that the worms intermesh, forming a practically continuous feeding device from one end of the passage to the other. The distributing screw and feeding screws are so gared as to enable them to be operated at variable speeds and independently of each other, all being conveniently operated by one man without moving from his situation on the platform.

In the operation of the machine the power is taken from overhead wires through the trolleys to operate the motor which drives the caterpillar treads so that the machine is propelled over the ground, the speed and direction being

controlled by the operator. Peat pumped into the hopper from a suitable conveyor falls on the large end of the ditsributing screw, and is thereby evenly distributed throughout the entire length of the trough. The small feeding screws take the peat from the distributing screw and force it out through he moulds, whence it is discharged in continuous ribbons from the rear end of the machine on the drying ground, and may be cut into lengths as desired by any suitable means. When the end of the run has been reached, the machine is turned and starts back beside its original path. The conveyor is suitably adjusted, and the cover of the trough and the distributing screw turned end for end, as the opposite side of the machine now travels adjacent to the conveyor. The machine may be adjusted to turn out a product of uniform consistency, either by adjusting the relation between the feeding and travelling speeds or by adjusting the relation between the distributing and feed screws according to variations in quality or amount of the peat supplied to it.

BRITISH AND FOREIGN PATENTS.

U.S. Patent 1,099,121, June 2, 1914.—G. H. Earp-Thomas.

Preparation of soil bacteria for commercial distribution by mixing them with a mixture of garden soil, humus and clay loam, sterilized by heat.

U.S. Patent 1,105,206, July 28, 1914.—F. C. C. Th. Ad. Osius.

Formation of fuel briquets from peat by pressing out the water, partially carbonizing by immersion in sulphuric acid, immersing in water to remove the sulphuric acid, and molding the resultant plastic mass.

British Patent 7643, April 1, 1913.—E. Eaton.

In the manufacture of a composition fuel, a mixture of 30 lbs. small coal, ground peat, or coke, 60 lbs. ground chalk, 3 lbs. crude oil or petroleum, and 10 lbs. solidified tar is heated by steam and briquetted.

German Patent 275,386, Nov. 10, 1912.—T. O. Franke.

In a process of expressing liquids from turf, fruit, etc., solid matter, impregnated with solid or liquid organic matter to prevent absorption of liquid, is added for the purpose of providing a solid indifferent body to assist in complete expression of the liquids. E.g. in obtaining cider, dry turf scrap is added after being impregnated with organic fat. Since the residual skins, etc., are used as fodder, this addition increases the value of the residue. If coke breeze is added to crude turf to express the contained liquid, animal or vegetable oils or fats, parrafin, ceresin or resin, naphthalene, asphalt, or the like are added to the coke to saturation before its use. The heating value of the product is increased.

British Patent 10,996, May 9, 1913.—L. von Alphen.

Fertilizer consisting of a solution of the substances that are abstracted from the soil by the plants for which the manure is used, but containing $FeSO_4$ instead of lime. The solution is absorbed in pulverized soft peat or peat dust, and the material is dried in such a manner as to retain the pulverized state. In an example given a solution of $(NH_4)_2SO_4$, anhydrous H_3PO_4, K_2O, and $FeSO_4$ is used.

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